TOTAL MAXIMUM DAILY LOAD
FOR TOXICS FOR THE CALCASIEU ESTUARY

Including Subsegments:

030301 Calcasieu Estuary and Ship Channel (Saltwater Barrier to Moss Lake)
030302 Lake Charles
030303 Prien Lake
030304 Moss Lake (including Olsen Bayou)
030305 Contraband Bayou
030306 Bayou Verdine
030401 Calcasieu River and Ship Channel (Below Moss Lake)
030402 Calcasieu Lake
030901 Bayou D'Inde

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Executive Summary

Introduction

The current 303(d) List for the Calcasieu River Basin was released under court order October 28, 1999 by U.S. Environmental Protection Agency (EPA) Region 6 in Dallas, Texas. Based on this list, draft Total Maximum Daily Loads (TMDLs) were developed for the estuarine subsegments of the basin.

This report documents the data and assessments used to establish TMDLs for a number of pollutants in accordance with the requirements of §303 of the Clean Water Act and EPA guidance.

The purpose of a TMDL is determine the pollutant loading that a waterbody can assimilate without exceeding the water quality standard for that pollutant. The TMDL consists of a wasteload allocation (WLA), a load allocation (LA), and a margin of safety (MOS). The WLA is the fraction of the total load apportioned to point sources. The LA is the fraction of the total apportioned to nonpoint sources. The MOS is a percentage of the TMDL that accounts for the uncertainty associated with model assumptions and data inadequacies.

Methodology

The methods used in developing the TMDL are summarized in the following subsections.

Pollutants of Concern Assessment

Several sources of information were used to determine pollutants of concern (POCs) for each subsegment. The following table summarizes how POCs were selected.

Source	Pollutants of Concern
EPA's court-ordered 303(d) List	All identified pollutants
Pollutants identified in a fish advisory	All identified pollutants
Within categories identified on the 303(d) list, pollutant concentrations in water compared to Louisiana's water quality standards and EPA's Recommended Water Quality Criteria	Pollutants with more than one exceedance of chronic water quality criteria or with the mean of detected values exceeding human health criteria
Within categories identified on the 303(d) list, pollutant concentrations in sediments compared to EPA's draft Equilibrium Partitioning Sediment Guidelines (ESGs) or the National Oceanic and Atmospheric Administration's Effects Range Median screening levels (ERMs)	Pollutants with sediment concentrations exceeding ESGs or ERMs for 10% or more of samples

Data sources for water and sediment pollutant concentrations were obtained from four sources: EPA Superfund data collected in 1999 and 2000; Louisiana Department of Environmental Quality Ambient Water Quality Network; the National Oceanic and Atmospheric Administration's Calcasieu Database, and data submitted by LDEQ to Region 6.

Pollutant Sources

UPSTREAM AND TRIBUTARY SOURCES. Upstream and tributary sources were estimated by multiplying the average water concentration of a pollutant in the nearest upstream or tributary subsegment times the upstream or tributary low flow.

POINT SOURCES. Permit Compliance System (PCS) data for all facilities were downloaded from EPA's website. Loads were estimated for each facility by averaging reported average monthly loads and determining the maximum daily load for each outfall, and then summing the results by pollutant across each process outfall discharging to a given waterbody. Permit limits for each facility with discharge data were also downloaded from the PCS database, and summed across all process outfalls for the facility by pollutant. Additional data were taken, when available, from permit fact sheets and permit applications.

Facilities evaluated appear in the following table.

NPDES	Facility	Receiving water
LA0000761	PPG Industries, Inc.	30301
LA0001333	WR Grace & Co	30301
LA0003026	Conoco Lake Charles Refinery	30301
LA0003336	Sasol North America Inc.	30301
LA0003689	Basell USA Inc Lake Charles Plant	30301
LA0003956	Holnam Inc., FKA Ideal Cement	30301
LA0005347	Lyondell Chemical World Wide Inc	30301
LA0005941	Citgo Petroleum Corporation	30301
LA0036340	City of Lake Charles WWTP	30301
LA0052370	Calcasieu Refining Company	30301
LA0067083	City of Sulphur WWTP	30301
LA0080829	Louisiana Pigment Company L.P	30301
LA0082511	Westlake Petrochemicals Corporation	30301
LA0087157	Westlake Styrene Corporation	30301
LA0103004	Westlake Polymers Corporation	30301
LA0036366	City of Lake Charles WWTP "B" & "C"	30305
LA0104850	McNeese Univ. Farm Labs	30305
LAG380006	City of Lake Charles Center St East WTP	30305
LAG380008	City of Lake Charles Center St West WTP	30305
LAG380009	City of Lake Charles Chennault WTP	30305
LAG380009	City of Lake Charles McNeese St WTP	30305
LA0000761	PPG Industries, Inc.	30306
LA0003026	Conoco Lake Charles Refinery	30306
LA0003336	Sasol North America Inc.	30306
LA0005347	Lyondell Chemical World Wide Inc	30306

NPDES	Facility	Receiving water
LA0003735	Reynolds Metals	30401
LA0039136	Cameron Parish Sewerage District	30401
LA0055522	Trunkline LNG	30401
LA0000761	PPG Industries, Inc.	30901
LA0003824	Firestone Polymers	30901
LA0005941	Citgo Petroleum Corporation	30901
LA0041025	Certainteed Corporation	30901
LA0047058	Tessenderlo Kerley Inc.	30901
LA0051730	Air Liquide	30901
LA0053708	Air Liquide	30901
LA0069850	Equistar Chemical	30901
LA0071382	West Lake Polymers-Lake Charles	30901
LA0100099	Praxair Inc.	30901
LA0101869	Cetco	30901
LA0105155	W-H Holdings Inc.	30901
LA0108596	Denmar Enterprises	30901

NONPOINT SOURCES. Nonpoint source estimates were developed for all subsegments for four pollutants: copper, lead, nickel, and ammonia. Loads were estimated based on land use, rainfall, and pollutant concentration in stormwater runoff.

ATMOSPHERIC SOURCES. Mercury deposition was determined by multiplying the deposition rate for mercury at Lake Charles times the surface area of each subsegment.

Total Maximum Daily Load Calculation

Two approaches were taken to determine appropriate TMDLs for the Calcasieu Estuary. They were a mass-balance approach (to ensure that the total load to a waterbody does not exceed its assimilative capacity) and the procedures used by LDEQ in developing water quality-based effluent limits (to ensure each discharge does not cause a localized water quality problem). Both are necessary to adequately protect each waterbody. Wasteload allocations are calculated for each pollutant of concern in a subsegment for each facility that is reasonably expected to discharge the pollutant. The smallest of the two allocations for each facility is then selected as the wasteload allocation.

Pollutants that are reasonably expected to be discharged by a facility are based on each facility's Standard Industrial Classification (SIC).

The assimilative capacity wasteload allocations are calculated as follows:

1 The assimilative capacity of a pollutant is determined as the most stringent water quality criterion times a conversion factor times the sum of tidal flows and process flows for each

facility to each subsegment. For acute and chronic aquatic life criteria, critical low flows are used; for human health criteria, harmonic mean flows are used.

2 Upstream and tributary loads are subtracted from the assimilative capacity.

3 An allowable load per mgd of facility process flows that are reasonably expected to discharge the pollutant is calculated by dividing the assimilative capacity by the sum of process flows for each subsegment for each pollutant.

4 Assimilative capacity-based wasteload allocations are calculated by multiplying the assimilative capacity per mgd times each facility's process flows.

The LDEQ wasteload allocations are calculated as follows:

1. The dilution factor is calculated as the effluent flow (Qe) divided by the product of the appropriate tidal flow (Qr) times the appropriate mixing zone fraction (Fs) plus the effluent flow, with all flows converted to the same units.
2. The wasteload allocation is the criterion (Cr) times the effluent flow (Qe) times a conversion factor divided by the dilution factor.

The applicable wasteload allocation is selection as the lesser of the assimilative capacity and LDEQ wasteload allocations.

Pollutants of Concern and Actions Identified

The following tables identify pollutants of concern for each subsegment of the Calcasieu Estuary, the basis for selection as pollutants of concern, and actions resulting from this analysis.

Bayou Verdine (030306)				
Medium	Category	Pollutant	Basis for Selection	Action
Water	Priority organics	1,2-Dichloroethane	On 303(d) List, water quality criterion exceedances	TMDL, monitor
		Phenols	On 303(d) List	TMDL, monitor
	Nonpriority Organics	None identified	On 303(d) List	Delist
	Metals	Copper	Water quality criterion exceedances	TMDL, monitor
		Mercury	Water quality criterion exceedances	TMDL, monitor
		Nickel	Water quality criterion exceedances	TMDL, monitor
Sediments	Organics	4,4'-DDT	ERM exceedances	TMDL, monitor
		Methoxychlor	ESG exceedances	TMDL, monitor
		PAHs	ERM exceedances	TMDL, monitor
	Metals	Zinc	ERM exceedances	TMDL, monitor
		Calcium	Sediment toxicity	TMDL, monitor
	Toxicity	Toxicity	On 303 (d) List	TMDL (addressed by above pollutants), whole effluent toxicity requirements, and monitoring

Bayou D'Inde (030901)

Medium	Category	Pollutant	Basis for Selection	Action
Water	Priority organics	Hexachlorobutadiene	On 303(d) List, Fish Advisory	TMDL, monitor
		PCBs	On 303(d) List, Fish Advisory	TMDL, monitor
		Bromoform	On 303(d) List	TMDL, monitor
		Tetrachloroethane	On 303(d) List	TMDL, monitor
		Hexachlorobenzene	Fish Advisory	TMDL, monitor
	Nonpriority organics	None identified	On 303(d) List	Delist
	Metals	Copper	Water quality criterion exceedances	TMDL, monitor
		Nickel	Water quality criterion exceedances	TMDL, monitor
	Other inorganics	None identified	N/A	Delist
Sediments	Metals	Mercury	ERM exceedances	TMDL, monitor
	Organics	None identified	N/A	TMDL (addressed by priority organics in water TMDLs*), whole effluent toxicity requirements
	Toxicity	Toxicity	On 303 (d) List	TMDL (addressed by above pollutants), whole effluent toxicity requirements, and monitoring

*Hexachlorobutadiene, hexachlorobenzene, and PCBs also accumulate in sediments, therefore organics in sediments are addressed.

Contraband Bayou (030305)

Medium	Category	Pollutant	Basis for Selection	Action
Water	Priority organics	None identified	On 303(d) List	Delist, monitor

Upper Calcasieu Estuary and Ship Channel (030301)

Medium	Category	Pollutant	Basis for Selection	Action
Water	Priority organics	None identified	On 303(d) List	TMDL (see below PAHs), monitor
	Others	Ammonia	On 303(d) List	Delist, monitor
		Copper	On 303(d), water quality criterion exceedances	TMDL, monitor
		Mercury	On 303(d), water quality criterion exceedances	TMDL, monitor
Sediment	Metals	Mercury	ERM exceedances	TMDL, monitor
	Organics	PAHs	ERM exceedances	TMDL, monitor
	Toxicity	Toxicity	On 303 (d) List	TMDL (addressed by above pollutants), whole effluent toxicity requirements, and monitoring

Lake Charles (030302)

Medium	Category	Pollutant	Basis for Selection	Action
Water	Priority organics	None identified	On 303(d) List	Delist, monitor
	Nonpriority organics	None identified	On 303(d) List	Delist

Prien Lake (030303)				
Medium	Category	Pollutant	Basis for Selection	Action
Water	Priority organics	None identified	On 303(d) List	Delist, monitor

Moss Lake (030304)				
Medium	Category	Pollutant	Basis for Selection	Action
Water	Priority organics	None identified	On 303(d) List	Delist, monitor
	Metals	Copper	On 303(d) List, water quality criterion exceedances	TMDL (upstream), monitor

Lower Calcasieu Estuary and Ship Channel (030401)				
Medium	Category	Pollutant	Basis for Selection	Action
Water	Priority organics	None identified	On 303(d) List	Delist, monitor

Calcasieu Lake (030402)				
Medium	Category	Pollutant	Basis for Selection	Action
Water	Priority organics	None identified	On 303(d) List	Delist, monitor

Subsegment Wasteload Allocations, Load Allocations, Margins of Safety, and TMDLs

Allowable loads were estimated for all pollutants of concern for all but one subsegment of the Calcasieu Estuary. Local loads to Moss Lake are so small in relation to loads being derived from upstream sources that an allowable load calculation was not deemed necessary.

The following table summarizes the allowable loads and load allocations made during the analysis.

Subsegment	Pollutant	Wasteload Allocation (pounds per day)	Load Allocation (pounds per day)	Margin of Safety (pounds per day)	TMDL (pounds per day)
Bayou Verdine (030306)	1,2-Dichloroethane	0.0	0.304	0.076	0.380
	Phenol	0.0	4.31	1.08	5.39
	PAHs (4 pollutants)	0.0	0.00219	0.00055	0.00274
	4,4-DDT	0.0	0.00000849	0.00000212	0.0000106
	Methoxychlor	0.0	0.000446	0.000112	0.000558
	Zinc	0.0	1.20	0.30	1.50
	Calcium	0.0	4,760	1,190	5,950
	Copper	0.0	0.0540	0.0135	0.0675
	Mercury	0.0	0.000372	.000093	0.000469
	Nickel	0.0	0.122	0.031	0.153
Bayou D'Inde (030901)	Hexachlorobutadiene	0.16591	0.00009	0.04150	0.20750
	PCBs	0.000015589	0.000000017	0.000003880	0.000019486
	Tetrachloroethane	2.804	0.006	0.703	3.513
	Bromoform	54.06	0.04	13.53	67.63
	Copper	1.285081	0.604919	0.472500	2.362500
	Hexachlorobenzene	0.000390	0.000001	0.000097	0.000488
	Mercury	0.0130	0.0000168	0.00322	0.0163
Upper Calcasieu Estuary (030301)	Copper	41.452	5.348	11.700	58.500
	Mercury	0.2859	0.0371	0.0808	0.4038
	PAHs (2 pollutants)	1.842	0.058	0.475	2.375

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ACRONYMS

AOC	Area of concern
BERA	Baseline Ecological Risk Assessment
CERC	Columbia Environmental Research Center, United States Geological Survey
CERCLA	Comprehensive Emergency Response, Compensation, and Liability Act
Cr	Criterion
EPA	United States Environmental Protection Agency
ERM	Effects Range Median
ESG	Equilibrium Partitioning Sediment Guideline
FS	Mixing zone fraction
LA	Load allocation (nonpoint source discharges)
LDEQ	Louisiana Department of Environmental Quality
MOS	Margin of safety (for wasteload and load allocations)
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PCS	Permit Compliance System
POC	Pollutant of concern
Qe	Effluent process flow (mgd)
Qr	Receiving water tidal flow (cfs)
Qt	Receiving water total flow (cfs)
RI/FS	Remedial investigation/feasibility study
SVOC	Semi-volatile organic compounds
TMDL	Total maximum daily load
TRIS	Toxic Release Inventory System
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VOC	Volatile organic compounds
WLA	Wasteload allocation (point source discharges)
WWTP	Wastewater treatment plant

INTRODUCTION

The Calcasieu Estuary[1] lies in southwestern Louisiana, bordered by the Mermentau River to the east and the Sabine River to the west. The Calcasieu Estuary consists of a complex structure of inter-connecting channels, loops, lakes, and bayous (Figure 1) that originates in the north at the saltwater barrier above Lake Charles and extends about 35 miles to the Gulf of Mexico. The main stem comprises two subsegments of the Calcasieu Estuary and Ship Channel (030301 and 030401) which are connected by Moss Lake (subsegment 030304). The major source of freshwater flow to the estuary is the Calcasieu River (subsegment 030201). The entire estuary is tidally influenced, although tidal ranges are limited at the northern end. The estuary is brackish, with low salinities at the northern end (ranging from 0 to 14 parts per thousand) and higher salinities at the southern end (ranging from 5 to 25 parts per thousand) (Louisiana Ambient Water Quality Monitoring Network Data). Salinities are largely determined by freshwater flows.

The Upper Calcasieu Estuary and Ship Channel (030301) is broadly connected in the north with Lake Charles (subsegment 030302), and is connected with Prien Lake (030303) in the south at three locations. Two loops of the Upper Calcasieu Estuary and Ship Channel (Clooney Island and Coon Island Loops) further complicate flow patterns. Three bayous flow into the Upper Calcasieu Estuary and Ship Channel. From north to south, Bayou Verdine (subsegment 030306) enters from the west to Coon Island Loop, Contraband Bayou (subsegment 030305) enters from the east just above Prien Lake, and Bayou D'Inde (subsegment 030901) enters from the west across from the northernmost connection with Prien Lake, just below Coon Island Loop. The combined flows from the Upper Calcasieu Estuary and Ship Channel, the bayous, and lakes flow into Moss Lake (subsegment 030304).

The outflow from Moss Lake forms the Lower Calcasieu Estuary and Ship Channel (subsegment 030401). The Gulf Intercoastal Waterway crosses the Lower Calcasieu Estuary and Ship Channel above Calcasieu Lake, and the northern part of Calcasieu Lake (subsegment 030402) connects just south of the crossing. The only other major connection with Calcasieu Lake is south of the bottom of the lake, although several small connections occur along its western shore. Below Calcasieu Lake, the Lower Calcasieu Estuary and Ship Channel flows to the Gulf of Mexico.

Freshwater and tidal flows in the estuary are very poorly understood. Over the last twenty years, various gauging stations have been operated for short periods of time, but a series of consistent data throughout the estuary has never been maintained. Two tributaries to the Calcasieu Estuary and Ship Channel (Bayou Verdine and Contraband Bayou) have never been monitored for either freshwater or tidal flows. Similarly, flows in Coon Island and Clooney Island Loops have never been studied, and the circulation patterns in three lakes (Lake Charles, Prien Lake, and Lake Calcasieu) are unknown (Moss Lake, which is essentially a wider part of the ship channel, has flows that are also unknown, but they can be inferred from flows above and below the lake).

The surface elevation of the northern portion of the Upper Calcasieu Estuary averages about 10 feet above mean sea level (msl). The area lies within the 100-year flood plain of the Calcasieu

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[1] This document uses the term Calcasieu Estuary to refer to all of the waterbodies in the Calcasieu River Basin below the saltwater barrier above Lake Charles. The main channel of the Calcasieu Estuary is referred to as the Calcasieu Estuary and Ship Channel.

River Basin (PRC 1994). The Upper Calcasieu Estuary ranges from 200 to 1,200 feet wide in the river channel to as much as 6,000 feet wide in the Lake Charles subsegment. The river channel ranges from 15 to 45 feet in depth.

The southern portion of the Upper Calcasieu Estuary ranges from 5 to 15 feet above national geodetic vertical datum (NGVD) and also lies within the 100-year flood plain of the Calcasieu River Basin (PRC 1994).

Land Use

The Calcasieu Estuary covers approximately 230,000 acres, and nearly 70% of the area is water or wetlands. Developed (industrial, commercial, and residential) land comprises less than 11% of the total area, but the percentage varies greatly among subsegment watersheds. Northern areas are more highly developed than southern areas.

The Lake Charles watershed is the most highly developed (developed land is 63% of the subsegment watershed area), followed by Contraband Bayou (58%), Prien Lake (41%), Bayou Verdine (39%), and Bayou D'Inde (31%). Developed land from Moss Lake south comprises less than 8% of any subsegment watershed area. Industrial land, however, comprises 24% of the Bayou Verdine watershed, 14% of the Upper Calcasieu River and Ship Channel watershed, 7% of the Bayou D'Inde watershed, and 5.4% of the Prien Lake watershed. Industrial land comprises less than 1% of all other subsegment watersheds.

Point Source Discharges

According to EPA's Permit Compliance System (PCS), there are 225 facilities in Calcasieu and Cameron Parishes that probably discharge to the Calcasieu Estuary system, but the receiving waters are not listed in PCS for many facilities. The great majority are industrial, commercial, and residential facilities that are likely to have small discharges (see list in Appendix Table E-15). The facilities with the largest discharges (the facilities containing monitoring data in PCS) generally lie west of the Ship Channel and discharge either to the Calcasieu Estuary and Ship Channel, Bayou Verdine, or Bayou D'Inde. There are, however, three wastewater treatment facilities that lie east of the Ship Channel, two of which discharge to Contraband Bayou. More details on major dischargers are presented in the discussion on individual subsegments later in this document.

Geology, Groundwater, and Climate

The Calcasieu River lies within the Gulf Coastal Plain physiographic province of southwestern Louisiana. The area primarily comprises geologically young, unconsolidated Quaternary (Pleistocene-age) sediments. Structurally, the area consists of a geosyncline that has and still receives large quantities of sediment from multiple river discharges (Louisiana Geological Survey [LGS] 1984).

Significant groundwater aquifers exist below the ground surface. Within the upper 1000 feet of Quaternary sediments, local aquifers include a shallow unconfined aquifer and the deeper confined, Chicot aquifer. These aquifers typically consist of sand and gravel units separated by clay aquitards (PRC 1994). Groundwater flow, fluctuation, and quality may be influenced by

surface water near Bayou Verdine, Bayou D'Inde, and Bayou Olsen (PRC 1994). Groundwater may discharge to surface water in some areas (PRC 1994).

Precipitation is relatively uniform from year to year. The average annual precipitation is 54 inches, with an average number of 103 rainy days (National Weather Service [NWS] Southern Region Climate Center 1999). The heaviest precipitation falls in May, June, and July; and March and October are the driest months. The average wind speed averages 8.6 miles per hour, from the south.

303(D) LIST

The current Section 303(d)[1] list was released under court order on October 28, 1999 by U.S. Environmental Protection Agency (EPA) Region 6 in Dallas, Texas. The estuary subsegments of the Calcasieu River Basin on the 303(d) list appear in Table 1. These subsegments are addressed by this document. Figure 1 is a reference map of these subsegments.

Table 1. Water Bodies and Pollutants Identified on 1999 303(d) List of Toxic Pollutants in the Calcasieu Estuary

Sub-segment	Description	Pollutants
030301	Calcasieu River[1] and Ship Channel – Saltwater Barrier to Below Moss Lake (Including Coon Island Loop and Clooney Island Loop)	Copper, Mercury, Priority Organics, Contaminated Sediments (Metals, Organics, Toxicity), Ammonia
030302	Lake Charles	Priority Organics, Non-Priority Organics
030303	Prien Lake	Priority Organics
030304	Moss Lake (Including Olsen Bayou)	Copper, Priority Organics
030305	Contraband Bayou	Priority Organics
030306	Bayou Verdine	Metals, Priority Organics Including Total Phenols; Ethylene Dichloride, Non-Priority Organics, Contaminated Sediments, (Metals, Organics, Toxicity)
030401	Calcasieu River[1] – Calcasieu Ship Channel below Moss Lake to the Gulf of Mexico	Priority Organics
030402	Calcasieu Lake	Priority Organics
030901	Bayou D'Inde – Headwaters to Calcasieu River	Priority Organics (Including Tetrachloroethane, Hexachlorobutadiene, Bromoform), Copper, PCBs, Non-Priority Organics, Other Inorganics, Contaminated Sediments (Metals, Organics, Toxicity)

1 This table refers to the estuarine portions of the Calcasieu River as the Calcasieu River and Ship Channel. To distinguish the estuarine portions from the upstream freshwater portion of the Calcasieu River basin, this document refers to the estuarine portion of the Calcasieu River as the Calcasieu Estuary and Ship Channel.

The Consent Decree signed on April 2, 2002 (Sierra Club et al. v Clifford et al., No. 96-0527, (E.D. La.)) addressed all state waters. Under this decree, the TMDLs for the Ouachita and Calcasieu Basins are required by May 31, 2002.

[1] References such as 303(d), 305(b) and 304(l) refer to sections of the Clean Water Act

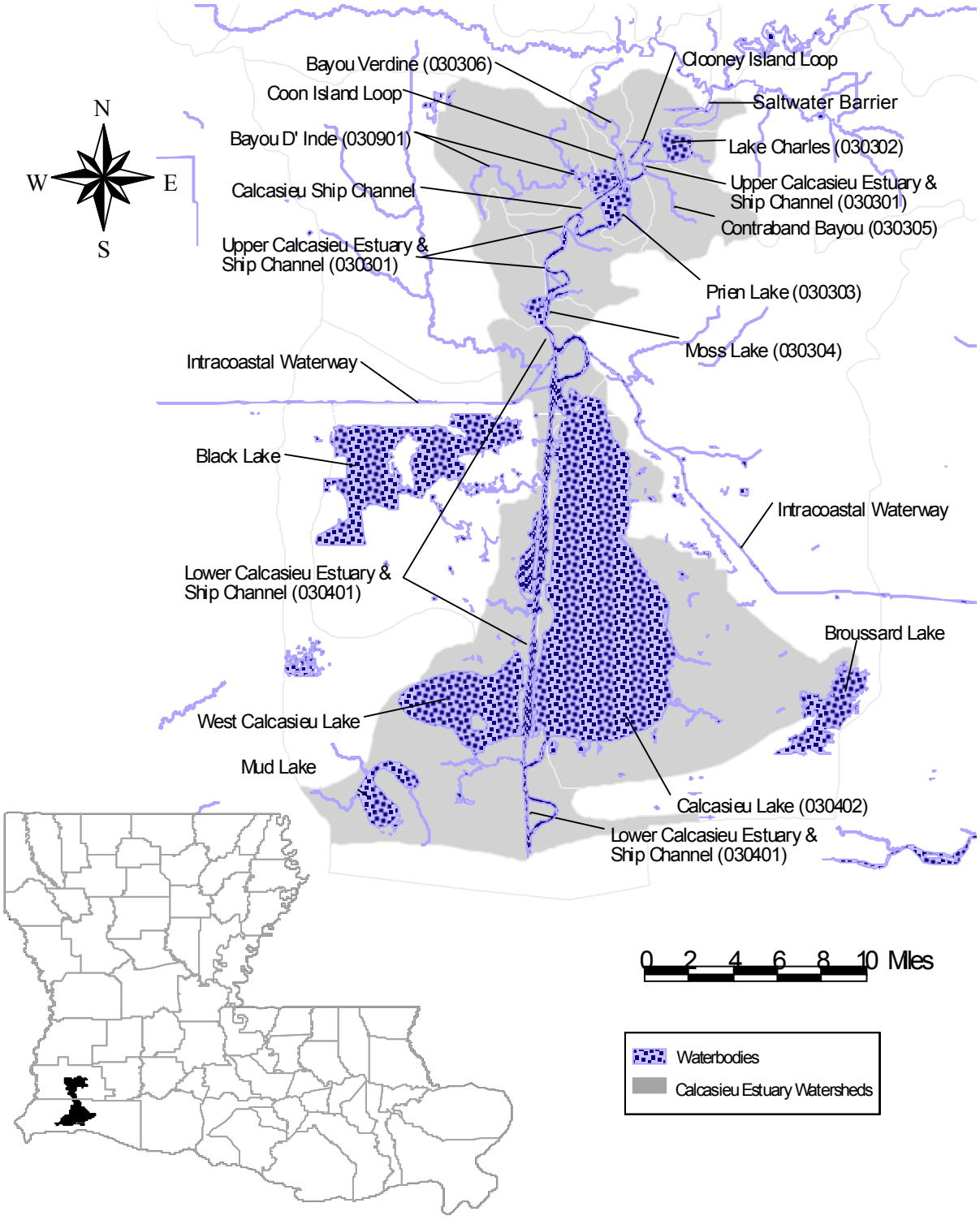

Figure 1. Calcasieu Estuary

Previous Investigations

Contamination in the Calcasieu Estuary has been a focus of attention for more than a decade. The high level of industrial activity in the area over the last several decades, much of which occurred prior to passage of the Clean Water Act and the formation of the National Pollutant Discharge Elimination System (NPDES) program, led to contamination of estuary sediments by a range of toxic pollutants such as polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and metals. The following paragraphs summarize the recent studies that have been conducted.

Toxics Study of the Lower Calcasieu River. Research Triangle Institute, March 1990.

This study was conducted by EPA Region 6, the Louisiana Department of Environmental Quality (LDEQ), and the U.S. Geological Survey (USGS). The study area included the Lower Calcasieu River, Bayou D'Inde, Bayou Verdine, Prien Lake, Lake Charles, Moss Lake, and Calcasieu Lake. Water and sediment samples were collected in June and July of 1988 and April of 1989. Water samples were mid-channel, mid-depth grab samples. Sediment samples were composites consisting of three grab samples (river locations). Grab samples were also collected from wastewater effluents from industrial facilities. Samples were tested for volatile organic chemicals, semi-volatile organic chemicals, PCBs, pesticides, heavy metals, common anions, conventional pollutants, and physical parameters. Toxicity testing of effluent, surface water, and sediment samples involved six bioassay species. The report concluded that a variety of organic and inorganic constituents result in high mortality rates in test species.

Bayou D'Inde, Lower PPG Canal, and Calcasieu River and Ship Channel Water and Sediment Sampling Report, ChemRisk, 1995.

ChemRisk prepared the Sediment Sampling Report for PPG Industries, Inc. The study assessed sediment and water quality in Bayou D'Inde, the Lower PPG Canal (which discharges to Bayou D'Inde), and a portion of the Calcasieu Ship Channel. Surface water sample locations that exhibited salinity stratification were sampled three feet above the sediment and in the middle of the fresh water layer. At non-stratified sample locations, one surface water sample was taken at two-thirds the depth of the water. Five-foot-long sediment cores were taken in the main channel of Bayou D'Inde, and 10-foot cores were taken in shallower locations. Water and sediment samples were analyzed for volatile and semivolatile organic compounds, PCBs, chlorinated pesticides, total petroleum hydrocarbons (i.e., gasoline and diesel), total and dissolved inorganic chemicals, ammonia, major anions, conventional pollutants, and physical parameters. Conclusions state that although many constituents were detected in surface water, there were no organic or inorganic contaminants that warranted additional characterization. However, most organic and inorganic constituents were detected in sediments, and additional characterization was deemed warranted because the extent of contamination was not adequately characterized.

Focused Site Investigation, Bayou D'Inde, U.S. EPA, July 1996.

This study was conducted by Fluor Daniel for EPA Region 6 as part of the CERCLA site investigation process. Sampling was initiated in response to a proposed dredging permit for the lower 1,000 feet of Bayou D'Inde. Sampling was designed to determine the areal extent of contamination in the lower bayou. Water sampling extended 5,000 feet upstream and 5,000 downstream of the confluence between the bayou and the Calcasieu Ship Channel, and sediment

core samples were taken in the lower 1,250 feet of the bayou, to depths between 10 and 20 feet. Results for semi-volatile organic compounds (SVOCs), volatile organic compounds (VOCs), inorganic elements, polychlorinated biphenyls (PCBs) and pesticides indicate sediment contamination to depths of up to 16.5 feet, with the highest levels of contamination in the upper four feet. The study found that approximately 65,000 cubic yards of contaminated sediments occurred in the area proposed for dredging.

LDEQ, Calcasieu Estuary Water Sampling Program, 1987-1996.

LDEQ measured ambient water conditions in parts of the Calcasieu Estuary on a monthly basis since 1987. LDEQ collected water samples from seventeen discrete sampling locations within the estuary. Stations range from the saltwater barrier near Lake Charles to the southern end of Calcasieu Lake, and include Bayou D'Inde, Prien Lake, and portions of the Calcasieu River and Ship Channel. Over the history of the program, LDEQ collected more than 2,000 water samples. LDEQ analyzed samples for VOCs and conventional parameters such as dissolved oxygen and salinity. LDEQ did not analyze the samples for SVOCs, pesticides, PCBs, or inorganic elements.

Remedial Investigation/Feasibility Study of Calcasieu River Areas Of Concern (AOC), Calcasieu Estuary Cooperative Site, Lake Charles, Louisiana, CDM 1999-2000

CDM sampled the Upper Calcasieu River AOC under Phases 1 and 2 of an RI/FS currently in progress for EPA Region 6. The RI/FS involves investigation and characterization of organic and inorganic pollutant contamination, as well as assessment of human health and ecological risk and determination of alternatives to mitigate unacceptable levels of environmental contaminants in the Upper Calcasieu River AOC.

Columbia Environmental Research Center (CERC), U.S. Geological Survey, An Assessment of Risks Associated With Contaminated Sediments in the Calcasieu Estuary: Use of the sediment quality triad. (In progress)

EPA Superfund Division supported a study to conduct a sediment quality triad assessment of the Calcasieu Estuary to quantify risk associated with contaminated sediments in the Calcasieu Estuary. The Triad assessment integrates information on sediment toxicity, chemistry, and benthic community structure in an integrated weight of evidence approach (Ingersoll *et al.* 1997).

Calcasieu Estuary Remedial Investigation/Feasibility Study (RI/FS): Baseline Ecological Risk Assessment (BERA), CDM 2001.

This document supports the design and implementation of a baseline ecological risk assessment (BERA), conducted as part of a remedial investigation and feasibility study (RI/FS). It defines the questions that need to be addressed in the BERA through a process known as problem formulation. The information developed during the problem formulation process is intended to provide a basis for evaluating the applications and implementation of the testable hypotheses, exposure pathway models, and measurement endpoints that have been proposed for the BERA. The problem formulation process is also intended to define how the information collected during the site investigation will be used to characterize exposures, ecological effects, and ecological risks, including associated uncertainties.

The preliminary list of pollutants of concern identified in the document included over 100 substances: metals, polychlorinated aromatic hydrocarbons (PAHs), PCBs, organochlorine and

other pesticides, chlorophenols, chlorinated benzenes, chlorinated ethanes, phthalates, cyanide, and acetone. After a scoping meeting, water-borne contaminants that occurred in concentrations in excess of their chronic aquatic life criteria or sediment-associated constituents in excess of the Effects Range Median (ERM) (or other comparable benchmarks), were considered pollutants of concern. Identified pollutants of concern are presented in Table 2. Table 3 summarizes the facilities and their discharged pollutants identified in the report.

Table 2. Pollutants of Concern Identified in CDM 2001

Medium	Pollutants of Concern
Water	Metals (copper and mercury)
	1,2-dichloroethane (DCE)
	Trichloroethane (TCA)
Sediment	Metals (copper, chromium, lead, mercury, nickel, and zinc)
	Polycyclic aromatic hydrocarbons (PAHs, acenaphthene, acenaphthylene, anthracene, fluorene, 2-Methylnaphthalene, naphthalene, phenanthrene, benzo(a)anthracene, fluoranthracene, pyrene, total PAHs, & other PAHs)
	Polychlorinated biphenyls
	Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans
	Chlorinated benzenes (hexachlorobenzene, hexachlorobutadiene, and degradation products)
	Phthalates (bis (2-ethylhexyl) phthalate)
	Carbon disulfide
	Unionized ammonia
	Hydrogen sulfide
	Acetone
	Organochlorine pesticides (aldrin and dieldrin)

Organization of Document

The remainder of this document presents the methodology used to develop TMDLs and a presentation of TMDL development for each subsegment of the estuary, subsegment by subsegment. Within each subsegment there is a presentation for each pollutant of concern.

The appendices contain the criteria used in making the assessment and in calculating TMDLs, summaries of ambient water and sediment quality data, and summaries of discharge data. These data summaries are also organized by subsegment.

Table 3. Facilities and Discharges Reported in CDM (2001)

Facility	Receiving Waters	Pollutants Discharged
PPG Industries	PPG Canal and Bayou D'Inde	Copper, lead, mercury, nickel, zinc, chlorinated hydrocarbons, dichloroethane, trichloroacetate, hexachlorobenzene, hexachlorobutadiene, sodium hypochlorite, sodium dichromate, sodium hydroxide, trichloroethylene, tetrachloroethylene, perchloroethylene, vinyl chloride, chloroform, bromoform, chlorodibromomethane, di-n-butyl phthalate, and others.
Conoco Inc.	Bayou Verdine and Calcasieu River	Oil, kerosene, diesel, naphtha, slop oil, dichloroethane, selenium, zinc, bis (2-ethylhexyl) phthalate, phenols, dimethyl disulfide, and polynuclear aromatic hydrocarbons
Citgo Petroleum	Bayou D'Inde and Calcasieu River	Arsenic, cadmium, chromium, zinc, phenol, 3-methylnonane, chlorine, hydrogen sulfide, phosphoric acid, benzene, ethylbenzene, toluene, ethylene, dichloride, naphthalene, polyethylene fibers, gasoline, fuel oil, lubricating oil, neutral oil, crude oil, o-cresol, methyl ethyl ketone, heavy gas oil, coker fuel, and heavy oil. volatile organic compounds and polynuclear aromatic hydrocarbons found in the surge pond.
Sasol North America	Bayou Verdine	Aluminum, copper, chromium, lead, nickel, zinc, tetrachloroethane, heavy oil, DEC, benzene, toluene, xylene, kerosene, sulfuric acid, sodium hydroxide, chloroform, methyl chloride, vinyl chloride, and vinyl chloride monomer
Olin Chemicals	Bayou Verdine, Calcasieu River, and Kelso Bayou	Arsenic, nickel, zinc, dichloroethane, tetramethyl piperidinone, chlorophosphate, ethanol, bis (2-ethylhexyl) phthalate, oil, ammonia, chlorine, chloroform, and monochlorobenzene.
OxyChem Petrochemicals	Bayou D'Inde	Cadmium, selenium, methylene chloride, naphthalene, bis (2-ethylhexyl) phthalate, dichloroethane, oil, sulfuric acid, and benzene
Westlake Polymers Corp	Bayou D'Inde	Chromium, copper, zinc, bromoform, chloroform, acetone, di-n-butyl phthalate, 2-methyl-2-propanol, oil, and bis (2-ethylhexyl) phthalate
Firestone Co.	Bayou D'Inde	Zinc, di-n-butyl phthalate, styrene, and oil and grease
W.R. Grace	Young's Bayou (into Calcasieu R.)	Aluminum, cadmium, nickel, and zinc

METHODOLOGY

Pollutants of Concern Assessment

Pollutants of concern (POCs) are pollutants that, because of their concentration in water or sediments, are toxic to aquatic life or pose a threat to human health. Several sources of information were used to determine POCs for each subsegment:

- EPA's court-ordered 303(d) List, which identifies pollutants that have degraded water quality;
- Pollutants identified in a fish advisory;
- Pollutant concentrations in water compared to Louisiana's water quality standards and EPA's Water Quality Criteria;
- Pollutant concentrations in sediments compared to EPA's draft Equilibrium Partitioning Sediment Guidelines (ESGs) and the National Oceanic and Atmospheric Administration's Effects Range Median screening levels (ERMs);
- Pollutant concentrations in fish tissue compared to values derived based on Louisiana's policy for setting fish advisories; and
- Results of a sediment toxicity identification evaluation (TIE) for parts of the estuary.

303(D) LIST

The 303(d) List (Table 1) identifies specific pollutants (e.g., copper, 1,2-dichloroethane) and categories of pollutants (priority organics, nonpriority organics, metals, toxicity) that cause impairment of the water or sediments of one or more subsegments of the Calcasieu Estuary. Specific pollutants identified on the 303(d) List were selected as pollutants of concern.

Pollutants of concern within categories of pollutants on the 303(d) List were identified by assessment of all existing and readily available water and sediment quality data (40 CFR 130.7(b)(5)).

FISH CONSUMPTION AND SWIMMING ADVISORIES

The Louisiana Department of Health and Hospitals (LDHH), in conjunction with the LDEQ, has issued a fish consumption and swimming advisory for Bayou D'Inde because of fish and sediment contamination with hexachlorobenzene, hexachlorobutadiene, and PCBs (http://www.deq.state.la.us/surveillance/mercury/fishadvi.htm). There is also a fish advisory for Bayou Olson, a tributary to Moss Lake. There is an informational advisory on fish contamination for the remainder of the estuary. These pollutants were selected as pollutants of concern for Bayou D'Inde. For other subsegments of the estuary, these pollutants were selected as pollutants of concern based on water, sediment, and fish tissue data. Methodologies are described in the sections Water and Sediment Data Sources and Methodology and Fish Tissue Data Sources and Methodology, below.

WATER AND SEDIMENT DATA SOURCES AND METHODOLOGY

This section describes the sources of data used to characterize pollutants in the water column and the methodology used to summarize the data.

EPA Superfund Data

CDM, under contract to EPA, took and analyzed a number of water samples for a variety of organic compounds and metals in several subsegments of the estuary as part of a Superfund RI/FS. These data are contained in a Microsoft Access database that was obtained from Region 6. The database contains over 150,000 records of pollutant-specific concentrations in water and sediments. To use this data for this study, each sample location (identified by latitude and longitude) was allocated to the appropriate subsegment of the estuary (See Appendix Figure C-2 for station locations). Data for stations in any of the subsegments of the Calcasieu Estuary covered by this document were extracted from the database.

For this study, the water and sediment data from the Microsoft Access database were analyzed separately. The water data contain results for both the dissolved fraction of metals and the total metal concentration. Dissolved data were used for evaluation of water quality exceedances, and total data were used for evaluating possible impacts on sediments.

Similarly, many sediment samples contain both pollutant concentrations and total organic carbon concentrations. Where possible, sediment pollutant concentrations were converted to concentration per gram organic carbon. The unconverted and converted sediment datasets were then analyzed separately. Note that the dataset with unconverted data contain all reported results—the underlying data for both the converted and unconverted datasets are the same.

For each subsegment and each pollutant, the number of samples, the number of detected values, the maximum detected value, and the mean of detected values were determined. These data are summarized in Appendix B.

LDEQ Ambient Water Quality Network Data

LDEQ maintains a database of monitoring data for a large number of waterbodies in Louisiana (http://www.deq.state.la.us/surveillance/wqdata/wqnsites.stm). All "general" and "metals" data from the website were downloaded for all subsegments of the Calcasieu Estuary, and the records were extracted into a Microsoft Access database. The Ambient Water Quality Network data is organized by subsegment, so there was no need to allocate sample locations to subsegments.

An individual record was created in the Microsoft Access database for each observation, and each record was marked as detected or nondetected (signified by a “K” in the Louisiana database). All records containing only blanks or zeros were then deleted from the database.

For each subsegment and each metal, the number of samples, the number of detected values, the maximum detected value, and the mean of detected values were determined.

The number of times a detected value of a pollutant in water exceeded its acute or chronic aquatic life dissolved criterion was also determined, and it was determined whether the mean of detected values exceeded its human health criterion.

Within each subsegment of the estuary, all metals with more than one detected value greater than an aquatic life dissolved criterion were selected as pollutants of concern. This approach is consistent with the approach taken by LDEQ for recent assessments sent to EPA (LDEQ 2001d). Similarly, all pollutants in a subsegment with means of detected values greater than a human health criterion were selected as POCs provided that the pollutant was detected more than once.

Data Submitted in Comments on the Draft TMDL

PPG Industries submitted a copy of a report that compares water column copper concentrations analyzed by conventional methods and concentrations analyzed by clean techniques.

LDEQ submitted an assessment of water quality for some of the subsegments based on water column samples analyzed with clean techniques.

National Oceanic and Atmospheric Administration's Calcasieu Data

NOAA's Office of Response and Restoration has compiled an environmental database covering several coastal waterbodies nationwide. Data for the Calcasieu Estuary were downloaded from NOAA's website (http://response.restoration.noaa.gov/cpr/qm/windowsqm.html) and imported into a Microsoft Access database. The data were filtered to obtain the results for only three studies (the database contains a version of the EPA Superfund data described above): 1996 EPA Bayou D'Inde Focused Site Invs, 1993-94 PPG B.Verdine/Coon Is/Ship Chan, 1994 PPG B.d'Inde/PPG Canal/Ship Chan. No other studies had data covering the relevant portions of the Calcasieu for recent years except for the 1999-2000 Superfund data.

Each result record was examined to determine if the reported value was detected or not. It was assumed that each record containing a "U" or a "B" as part of the QUAL_CODE field was not detected. All other values were assumed to be detected.

Each sample location (identified by latitude and longitude) was allocated to the appropriate subsegment of the estuary.

For each subsegment and each pollutant, the number of samples, the number of detected values, the maximum detected value, and the mean of detected values was determined.

If 10% or more of detected values of a pollutant in a subsegment exceeded an ERM, the pollutant was selected as a pollutant of concern. This rule of thumb identified those pollutants that were likely to cause sediment toxicity over relatively large areas. Since ERMs are based on sediment toxicity, this approach is consistent with Louisiana's narrative toxicity standard (LAC 33:IX.1113.A.5).

Fish Tissue Data

PPG Industries, Inc., the Louisiana Department of Health and Hospitals, and LDEQ participate in the Calcasieu Estuary Biological Monitoring Program. This program analyses and reports on concentrations of a range of organic pollutants in fish species throughout the estuary. The Year 12 Annual Report 2000 - 2001 was obtained from PPG and the data for hexachlorobenzene, hexachlorobutadiene, and Aroclor 1254 extracted and summarized. Results appear in Appendix D.

During the 1990s, several small studies on mercury contamination in fish were conducted in Bayou D'Inde and the upper Calcasieu Estuary and Ship Channel. The data were compiled into a database by NOAA's Office of Response and Restoration. These data were downloaded from NOAA's website (http://response.restoration.noaa.gov/cpr/qm/windowsqm.html), and the data summarized by species and subsegment. Results appear in Appendix D.

Water-based Pollutants of Concern

For each pollutant on Attachment A of the consent decree and for categories of pollutants on the court-ordered 303(d) List, water column data (Appendix B) were compared against pollutant-specific criteria contained in Louisiana Numerical Criteria for Specific Toxic Substances (LAC 33.IX.1113.C.6) (hereafter referred to as criteria). If Louisiana standards contain no criteria for a pollutant, EPA's recommended Water Quality Criteria (http://www.epa.gov/ost/pc/revcom.pdf) were used as water quality criteria based on Louisiana's narrative toxicity standard (LAC 33:IX.1113.A.5). Criteria are presented in Appendix A.

The number of times a detected value of a pollutant exceeded an acute or chronic aquatic life dissolved criterion was determined. It was determined whether the mean of detected values exceeded a human health criterion.

Within each subsegment of the estuary, all pollutants with more than one detected value greater than an aquatic life dissolved criterion were selected as pollutants of concern. Similarly, all pollutants in a subsegment with means of detected values greater than a human health criterion were selected as POCs provided that the pollutant was detected more than once. These approaches are consistent with section 305(b) guidelines, and current practices in assessing human health water quality criteria.

LDEQ provided an assessment of subsegments based on concentrations of a few pollutants analyzed by clean techniques. The assessment indicated that nickel exceeds applicable marine criteria in Bayou Verdine, so nickel was selected as a pollutant of concern.

Sediment-based Pollutants of Concern

For pollutant categories identified on the court-ordered 303(d) List, pollutants of concern based on sediment data were identified in one of two ways. The converted dataset (units of µg/g organic carbon) was compared to EPA's draft Equilibrium Partitioning Sediment Guidelines (ESGs, see Appendix A). If 10% or more of detected values of a pollutant in a subsegment exceeded its ESG, it was selected as a pollutant of concern based on Louisiana's narrative toxicity standard (LAC 33:IX.1113.A.5). Similarly, the unconverted dataset (units of µg/kg) was compared to NOAA's Effects Range Median screening levels (ERMs, see Appendix A). If 10% or more of detected values of a pollutant in a subsegment exceeded an ERM, it was selected as a pollutant of concern.

The location of pollutants of concern that exceeded either water quality criteria or sediment quality guidelines were plotted on a map of the estuary as an aid in understanding sources of pollutants with exceedances. These maps appear in Appendix C.

Source Assessment

Upstream and Tributary Sources

Upstream and tributary sources were estimated by multiplying the average water concentration of a pollutant in the nearest upstream or tributary subsegment times the upstream or tributary low flow. Upstream concentration data were generally limited to metals for which the low flow assumption is appropriate. Also, there are few data for organic pollutants or concentrations of organic compounds of interest in upstream or tributary waters. When no data were available or the great majority of upstream samples were not detected, a zero load was assumed.

Point Sources

Information about all facilities in the Calcasieu Estuary were obtained from EPA's Permit Compliance System (PCS) and, many comments were received on the Draft TMDL. For facilities identified in comments on the Draft TMDL by LDEQ, facility NPDES permits, fact sheets, and in some cases, permit applications and the most recent year's discharge monitoring reports (DMRs) were evaluated.

General information about all facilities in Calcasieu and Cameron Parishes was downloaded from EPA's Permit Compliance System (PCS) database to establish a full list of discharges to the upper Calcasieu Estuary (www.epa.gov/enviro/html/pcs/pcs_query_java.html). These facilities are listed in Appendix E. Discharge data for all facilities that discharge to the Calcasieu Estuary (Hydrologic Unit Code [HUC] 08080206) were then downloaded. Those facilities in Calcasieu and Cameron Parishes that had no entry for HUC were searched facility-by-facility to determine whether PCS contains discharge data for them.

Locations of discharges were taken from facility NPDES permits and fact sheets.

All facilities with latitude and longitude data appear in Appendix Figure C-1. Facilities with discharge information appear in Appendix Figure C-2.

Appendix Table E-1 presents all facilities evaluated.

Appendix Table E-3 presents reported average and maximum flows for each facility for each outfall.

Appendix Table E-4 presents the average flows recorded in permit fact sheets for facilities that have no flow data in PCS. Some facilities have no flow data in the fact sheets, either, but none of these facilities are located on subsegments that are subject to TMDLs.

Permit limits for pollutants of concern for each facility were downloaded from the PCS database. These limits were checked against limits in the most recently issued permit for each facility and modified as appropriate. Where no permit limits were identified in PCS, limits were taken from the most recently issued permit.

Appendix Table E-6 presents the effluent limits for pollutants of concern, by facility, outfall, and pollutant.

PCS reports average monthly and maximum daily loads by outfall. Many of the outfalls listed are stormwater outfalls, and larger facilities often have a number of process, nonprocess, and

stormwater outfalls. All data by facility by outfall were downloaded, and the average load of each pollutant for each outfall (the average of the reported average loads) and the maximum load of each pollutant for each outfall (the maximum reported load) were determined.

Where concentrations or loads appear as "<" values (nondetects), a value of 1/2 of the detection limit was assumed in calculating loads. Some facilities, however, reported nondetects as zeros. These values were not included in the calculations of average and maximum daily loads, but the number of nondetects are recorded to allow interpretation of the reported loads.

Calculated loads by facility by outfall appear in Appendix Table E-7.

NONPOINT SOURCES

Nonpoint source estimates were developed for all subsegments for four pollutants: copper, lead, nickel, and ammonia. These are the pollutants for which there are substantial data on pollutant concentrations in urban runoff, the major nonpoint source for these pollutants.

Several documents were examined for appropriate methodologies to use to estimate nonpoint source loads. These included Modeling of Nonpoint Source Water Quality in Urban and Non-urban Areas (EPA 1991), Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants in Surface and Ground Water--Part 1 (Revised--1985)(EPA 1985), and Principles of Surface Water Quality Monitoring and Control (Thoman and Mueller, 1987). All of the models in these documents that were considered appropriate to use required substantially more detailed information than is available for the Calcasieu Estuary. Consequently, a more simple approach was adopted.

Nonpoint source loads were estimated based on a model downloaded from the Center for Watershed Protection website at: www.stormwatercenter.net/monitoring%20and%20assessment/simple%20meth/simple.htm. The model uses land use areas, annual rainfall, percent imperviousness, and average concentrations of pollutants to predict annual loads.

Land use data was obtained from the Louisiana GIS (http://atlas.lsu.edu/search/searchAtlas.htm), which is based on 1980 USGS land use data. No more recent land use data are available. All industrial, commercial, residential, and infrastructure land uses were grouped into an urban land category, and an average percent imperviousness of 60% was applied uniformly across the urban land category. Annual average rainfall of 54 inches was used, and concentrations of zinc, lead, and copper were taken from the median event, median concentrations reported in the Results of the Nationwide Urban Runoff Program (EPA 1983) for all sites (copper, 0.047 mg/L; lead, 0.18 mg/L, and zinc, 0.176 mg/L). The ammonia concentration was taken from the storm water center website listed above (1.1 mg/L). No other national or local databases that could be used to estimate stormwater concentrations for other pollutants were found.

Output from the model is an average annual nonpoint source load, but for assessing the significance of nonpoint sources during low flow conditions, the loads need to be adjusted. This was done by multiplying the annual load times the ratio of the mean flow for a subsegment to its 7Q10 flow. The resulting loads were then divided by 365 to obtain daily low flow urban nonpoint source loads.

Estimated average and low-flow nonpoint source loads appear in Appendix Table F-1.

ATMOSPHERIC SOURCES

There are limited sources of data for emissions and deposition of atmospheric sources in either Calcasieu or Cameron Parishes. Data were obtained in two forms: air releases and air deposition. Procedures employed to access and manipulate the data are described in the following paragraphs.

To gain an appreciation of total releases of pollutants of concern, Toxic Release Inventory System (TRIS) data were obtained from both EPA and Louisiana. The data in the two versions were essentially identical. Data were extracted from the database for the years 1996 - 1999 for Calcasieu, Cameron, Beaurgard, and Allen Parishes. The great majority of facilities reporting releases, however, were in Calcasieu Parish.

Once the data were downloaded, they were summed by pollutant across all years and divided by the number of days in four years. This resulted in an average daily release of each pollutant in pounds per day. The resulting release data appear in Appendix Table F-5. These data were used to determine if appreciable atmospheric loads might occur for a variety of pollutants, although it was not possible to estimate atmospheric loads for any pollutant from the available data.

Air deposition data are available for only one pollutant of concern, mercury. The annual deposition of mercury at National Atmospheric Deposition Program station LA05 near Lake Charles, Louisiana is 10.6 $\mu g/m^2$ (Christina Laurin, FTN Associates[2], personal communication). This value was used to estimate atmospheric mercury loads to each subsegment by multiplying by the subsegment surface area in square meters and dividing by 365 to get an average daily atmospheric load. The load was then converted to pounds per day to make it comparable with other load estimates for the estuary. The resulting loads appear in Appendix Table F-4. The accuracy of the estimate is best in the Lake Charles area, but atmospheric loads are likely overestimated in more downstream parts of the estuary. Overestimation would be highest for large, open waterbodies considerably south of the monitoring station—areas such as Calcasieu Lake—because, with the absence of significant sources in the Gulf of Mexico and the predominantly southern winds, deposition over coastal areas would tend to be lower than deposition over the Lake Charles area.

Total Maximum Daily Load Calculation

A total maximum daily load (TMDL) is a written plan established to ensure that a waterbody will attain and maintain water quality standards. It includes consideration of existing pollutant loads and reasonably foreseeable increases in pollutant loads. It is intended to provide an opportunity to compare relative contributions from all sources and consider technical and economic trade-offs between point and non-point sources. The following steps comprise the process for establishing a TMDL for a pollutant of concern:

- Estimate waterbody assimilative capacity
- Estimate loads from all sources to the waterbody
- Determine total allowable load

[2] FTN Associates is developing the mercury TMDL for the Gulf Coastal Waters and Estuaries.

- Allocate (with a margin of safety) the allowable load among sources.

A TMDL is the maximum daily load of a pollutant that can be discharged to a waterbody that ensures applicable water quality criteria will be met, such that water quality standards are achieved. Ideally, TMDLs should be based on the results of a water quality analysis that estimates the fate of a pollutant in a waterbody based on known and quantified sources of pollutants and known and quantifiable natural processes. Accurate predictions, however, require site-specific data for a variety of parameters that are not routinely measured. Nevertheless, data from other locations can be used to estimate the importance of those natural processes for which there are no site-specific data. While there are extensive data for the Calcasieu Estuary for some parameters (concentrations of pollutants in sediments, for example), there are limited data on a variety of parameters that can affect the fate and effects of discharged pollutants. The most significant limitation is with freshwater and tidal flows, particularly for tributaries to the Calcasieu Estuary and Ship Channel, loops, and lakes.

In any water body, the major natural processes that affect the fate of pollutants are:

- Advective flow (water flow from upstream to downstream),
- Tidal dispersion (upstream and downstream flow caused by tides),
- Settling of pollutants attached to suspended solids in the water column and resuspension of pollutants attached to sediments,
- Transport of sediments upstream and downstream through advective and tidal water movement, and
- Diffusion of dissolved pollutants from the water column to sediment pore water and diffusion of dissolved pollutants in the sediment pore water to the water column.

WATER QUALITY MODELING DATA SOURCES

The Water Quality Analysis Simulation Program-6 (WASP6, Wool et al, 2001) was initially selected for modeling the Calcasieu Estuary because it has the capability of handling all of these processes. WASP6 is a dynamic compartment modeling program for aquatic systems that includes both the water column and the underlying sediments.

Although the WASP6 modeling system provides an excellent general tool to model the natural processes that determine the fate of various pollutants in the Calcasieu Estuary, data that can be used to estimate these processes in the Calcasieu Estuary are extremely limited. Because of these limitations, model results varied over a large range, depending on assumptions made about parameters for which there were no data. As a result, the use of the model as a quantitative tool to estimate allowable loads was not deemed appropriate. Nevertheless, the model was used to explore the importance of the processes that affect the fate of pollutants in the estuary.

Advective Flow

While there are advective flow data for various time periods for some subsegments, there are no flow data for other time periods or subsegments. Generally, flow data are available for the main

channels of the estuary, but not available for Lake Charles, Prien Lake, Calcasieu Lake, Clooney Island, and Coon Island Loops. Similarly, there are no flow data for Contraband Bayou, Bayou Verdine, and all other tributary sources to the estuary except Bayou D'Inde. When attempts were made to estimate runoff from tributary sources, resulting flows were inconsistent with other data that were available.

Tidal Dispersion

Tidal dispersion has the effect of distributing specific discharges of pollutants upstream and downstream. The incorporation of tidal dispersion in a model thus results in a lower predicted concentration in a receiving waterbody than if dispersion was not included. Information on tidal dispersion is lacking for much of the estuary.

In developing NPDES permits for facilities, Louisiana calculates the flow over a tidal cycle by estimating the volume of water that enters a waterbody over a tidal cycle and dividing by the tidal period as a method to incorporate the effects of tidal dispersion (as specified in LDEQ 2001e). While this procedure results in a considerably higher flow than the advective flow, and higher flows result in greater dilution, it is a maximum estimate of the dilution capacity of a given waterbody at a given point. Nevertheless, these are the only consistent estimates of tidal flows and they are available for each subsegment for which TMDLs are calculated. The maximum tidal flows for each of the subsegments for which TMDLs are calculated appear in Table 4.

Table 4. Maximum Tidal Flows by Subsegment

Subsegment	Waterbody	Harmonic Mean Flow (cfs)	Critical Low Flow (cfs)
030301	Upper Calcasieu Estuary	9,010	3,003
030305	Contraband Bayou	96	32
030306	Bayou Verdine	10.4	3.46
030401	Lower Calcasieu Estuary	2,880	960
030901	Bayou D'Inde	363	121

Source: NPDES Permit Fact Sheets

While these are the only consistently estimated tidal flows, there is concern that these estimates are not sufficiently accurate to ensure the waterbodies would be protected if effluent dilutions are calculated using them. At low flow, for example, with essentially no downstream movement of pollutants (as is the case with Bayou Verdine), a facility would discharge into essentially the same volume of water on consecutive tides. Although there would be some mixing of the receiving water volume with presumably more dilute water downstream during each tidal cycle, the mixing would be far from complete. There are, however, no data that allow the estimation of the extent of mixing at any point in the estuary.

Particulate Deposition and Resuspension

Many toxic pollutants, including most metals and those pollutants with elevated concentrations in sediments, attach strongly to particles and behave more as if they were particles than if they were dissolved in the water column. With low flows (and low turbulence), any particles (with attached pollutants) tend to settle out of the water column to the sediments. At higher flows (and higher turbulence), some settled particles are resuspended into the water column and transported downstream. However, there are no data on the fraction of organic pollutants that are attached to particles or the particles to which they may be attached.

The rate at which particles settle and their propensity to be resuspended depends primarily on their density. If particles have a density greater than that of water, their tendency is to settle out of the water column. The greater the differential between the density of water and the density of the particle, the greater the tendency for particles to settle to and remain in the sediments.

Although the amount of metallic pollutants (e.g., copper, mercury, and lead) that are attached to particles in various subsegments of the Calcasieu Estuary can be estimated as the difference between the total and dissolved form of pollutant, the density of the particles to which they are attached is unknown. Given that most point source facilities have settling as part of their treatment train, particles derived from point sources tend to be less dense than particles associated with other sources, such as nonpoint sources. But this does not change the fact that the density of the source particles and the density of the particles in the receiving water is not known.

In running the water quality model under a variety of assumptions related to source and instream particulate densities, the net effect of including particle settling and resuspension is to reduce the predicted receiving water concentration for a given load, particularly at low flow. In other words, when particle settling and resuspension are addressed in the model, a greater total maximum daily load results. The increased loading, however, results in increased sedimentation, an undesirable result where contaminated sediments are an issue. Therefore, in the absence of data (as well as to prevent overestimating the allowable load that increases sediment loadings) particle settling and resuspension were not included when estimating waterbody assimilative capacity.

Water Column/Sediment Pore Water Interaction

Pollutants in the water surrounding sediment particles (sediment pore water) diffuse into or from the water column based on the relative concentrations of pollutants in the water column and pore water. Given the sediment concentrations of some pollutants in sediments, it was suspected that the sediments could be supplying significant amounts of pollutants to the water column. If this were true, then the assimilative capacity of the waterbody should be reduced by the amount of a pollutant that diffuses from the sediment to the water column.

Diffusion is a very slow process, and diffusion from the sediments to the water column is most significant with high sediment concentrations, low water column concentrations, and low flows. Using a variety of diffusion rates from the literature, the relative contribution of diffusion from pore water to the water column was examined in three model runs for copper in Bayou D'Inde and three model runs for benzo (a) pyrene in Bayou Verdine using loads expected to result in the most stringent water quality criterion for the pollutant. The highest sediment copper

concentration occurs in Bayou D'Inde, and the highest sediment benzo (a) pyrene concentration occurs in Bayou Verdine. The model runs showed that sources of copper and benzo (a) pyrene other than sediment contribute more than 99.99% of the load to the water column. For this reason, sediment concentrations were ruled out as a potential source of pollutants to the water column.

TOTAL MAXIMUM DAILY LOAD ESTIMATES

Two approaches were taken to determine appropriate TMDLs for the Calcasieu Estuary. They are a mass-balance approach (to ensure that the total load to a waterbody does not exceed its assimilative capacity) and the procedures used by LDEQ in developing water quality-based effluent limits (to ensure each discharge does not cause a localized water quality problem). Both are necessary to adequately protect each waterbody. Wasteload allocations are calculated for each pollutant of concern in a subsegment for each facility that is reasonably expected to discharge the pollutant. The smallest of the two allocations for each facility is then selected as the wasteload allocation.

Pollutants that are reasonably expected to be discharged by a facility are based on each facility's Standard Industrial Classification (SIC). The pollutants are identified based on EPA's Effluent Guidelines, an inspection of existing facility permit limits, comments on the Draft TMDL, and best professional judgment (where existing information is limited). Each facility's primary SIC is presented in Appendix Table E-1. Appendix Table E-2 presents those pollutants reasonably expected to be discharged by each SIC.

The assimilative capacity wasteload allocations are calculated as follows:

1 The assimilative capacity load of a pollutant is determined as the most stringent water quality criterion times a conversion factor times the sum of the maximum appropriate waterbody tidal flow (Table 4) plus the sum of average process flows for each facility that is reasonably expected to discharge the pollutant to the subsegment. For acute and chronic aquatic life criteria, critical low flows are used; for human health criteria, harmonic mean flows are used. Facility process flows for each subsegment are presented in Appendix Tables E-3 and E-4. The summed process flows for each facility in each subsegment are presented in Appendix Table E-5. (Note that the 20% margin of safety is subtracted at this point.)

2 Upstream and tributary loads are subtracted from the assimilative capacity. (Note that the only appreciable upstream plus tributary load is for copper to the Upper Calcasieu Estuary.)

3 An allowable load per mgd of facility process flows that are reasonably expected to discharge the pollutant is calculated by dividing the assimilative capacity by the sum of process flows for each subsegment for each pollutant (Appendix Table E-10).

4 Assimilative capacity-based wasteload allocations are calculated by multiplying the assimilative capacity per mgd times each facility's process flows (Appendix Table E-12).

The LDEQ wasteload allocations are calculated as follows:

1. The dilution factor is calculated as the effluent flow (Qe) divided by the product of the appropriate tidal flow (Qr) times the appropriate mixing zone fraction (Fs) plus the effluent flow, with all flows converted to the same units.
2. The wasteload allocation is the criterion (Cr) times the effluent flow (Qe) times a conversion factor divided by the dilution factor. Calculations and results appear in Appendix Table E-13)

The applicable wasteload allocation is selection as the lesser of the assimilative capacity and LDEQ wasteload allocations (Appendix Table E-14).

Monitoring

For each pollutant of concern in each subsegment, an appropriate monitoring program was developed based on the level of available information. In each case, an ambient monitoring program was deemed appropriate for at least two reasons: to determine whether water quality criterion values are exceeded in the waterbody and to assess trends in water quality. For pollutants that exceed sediment quality guidelines, an ambient monitoring program was deemed appropriate to determine trends in sediment concentrations. With appropriate controls, sediment concentrations should decline over time. With inadequate controls, however, sediment concentrations would increase.

TMDLS FOR SUBSEGMENT 030306, BAYOU VERDINE

Bayou Verdine lies between the cities of Westlake and Mossville, north-northwest of Lake Charles in the Calcasieu Estuary. Bayou Verdine's headwaters originate in the farmland north of Mossville and flow primarily south-southeast, entering the Calcasieu Estuary at the north end of Coon Island Loop. Bayou Verdine is approximately 4.2 miles long, and the bayou is the only major tributary to Calcasieu River-Coon Island Loop. See Figure 2 for the location of subsegment 030306.

Relief in the area ranges from 5 to 15 feet above national geodetic vertical datum (NGVD). The area surrounding Bayou Verdine lies within the 100-year flood plain of the Calcasieu Estuary Basin (PRC 1994). Its headwaters are fresh and mix with brackish water of the Calcasieu Estuary to the south.

According to the U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory Map, the upper reaches of Bayou Verdine (from point of origin to I-10) comprise a palustrine wetland system that is periodically flooded during storms and a riverine portion that is permanently flooded. The upper reaches of the bayou have water depths ranging from 4 to 7 feet and are not tidally influenced. The lower reaches of the bayou are tidally influenced, with up to three inches of daily water level fluctuation. It has depths of up to 20 feet. Near the confluence of Bayou Verdine and the Coon Island Loop, Bayou Verdine and shallow groundwater are in direct contact (PRC 1994).

Pollutants of Concern

EPA's 303(d) list identifies metals, priority organics, and nonpriority organics as pollutants of concern in Bayou Verdine in the water column. Two specific priority organic compounds are identified: 1,2-dichloroethane (ethylene dichloride) and phenols. Metals, organics, and toxicity are identified as pollutants of concern in the sediments.

Using the procedures specified in the Methodology section, 18 pollutants are identified as pollutants of concern (Table 5). Two of the pollutants of concern are priority organic compounds that are specifically identified on EPA's 303(d) List. Available data (one sample) indicate no other priority organic compounds exceed water quality criteria (Appendix Table B-26). Two of the pollutants are selected as pollutants of concern because of water quality criterion exceedances. The remainder are selected because of sediment quality guideline exceedances.

TMDLs for these pollutants are developed in the following subsections. The subsections are organized by the basis for selection as pollutants of concern.

303(D) LIST

EPA's 303(d) List identifies priority organics, 1,2-dichloroethane, phenols, nonpriority organics, metals, and contaminated sediments as causing impairment in Bayou Verdine. Each of these is discussed in the following sections.

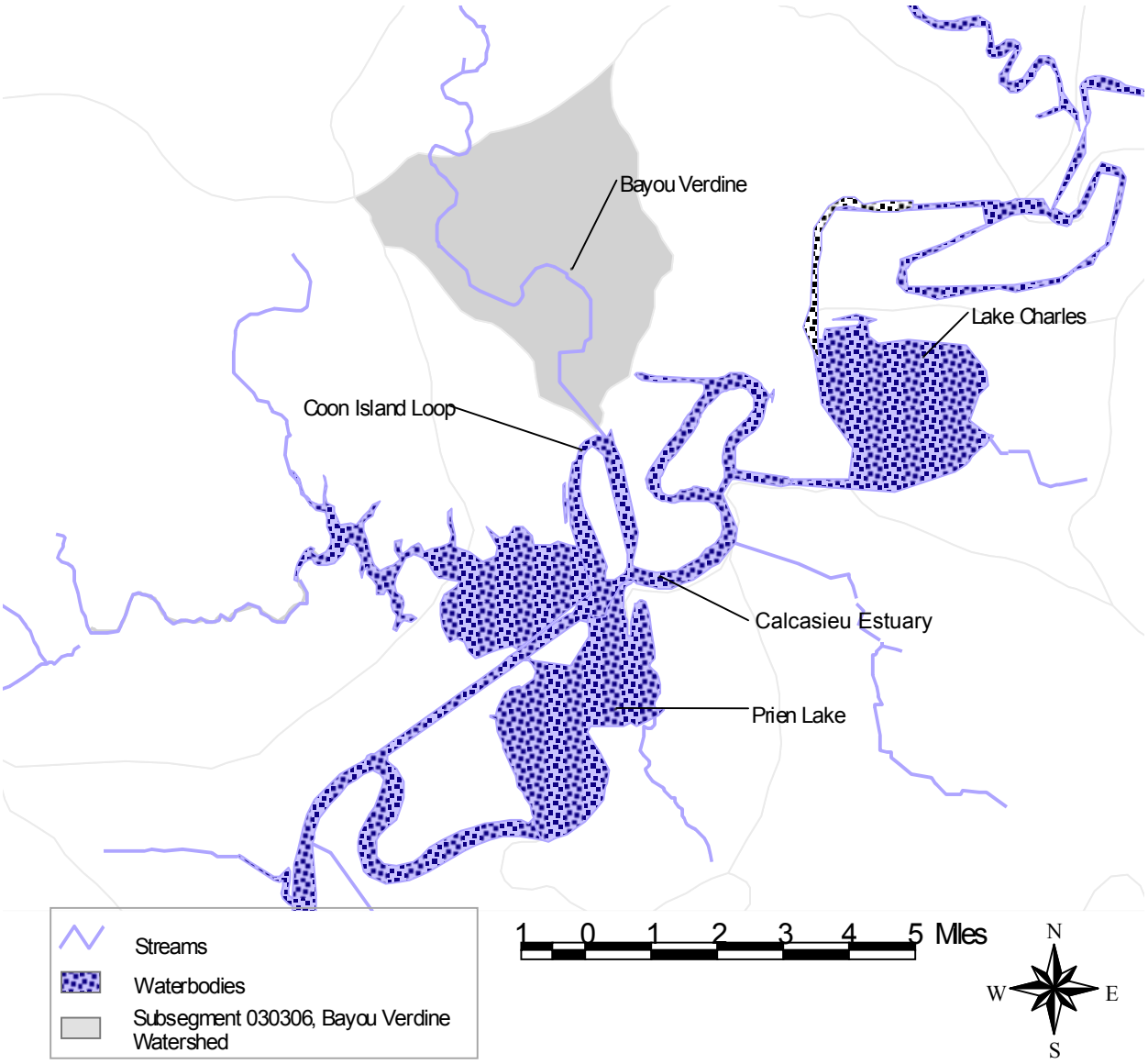

Figure 2. Location of Subsegment 030306, Bayou Verdine

Priority Organics

Based on available data, 1,2-dichloroethane is the only priority organic pollutant that exceeds Louisiana's water quality criteria or EPA's recommended water quality criteria (Appendix Table B-26). EPA's 303(d) List also indicates phenols as a pollutant of concern. TMDLs for these pollutants are developed below.

MONITORING AND FOLLOW UP. Consistent with EPA Region 6's Policy for Third Round NPDES Permitting (EPA 1992a) and Post Third Round Permit Implementation Strategy (EPA 1992b) or the most recent revisions thereof, all major and significant minor dischargers to Bayou Verdine

Table 5. Pollutants of Concern for Bayou Verdine

Pollutant	Medium	Basis for Selection
Priority Organics	Water	On 303(d) List
1,2-Dichloroethane	Water	On 303(d) List, water quality criterion exceedances
Phenols	Water	On 303(d) List
Nonpriority Organics	Water	On 303(d) List
Metals	Water	On 303(d) List
Mercury	Water	Water quality dissolved criterion exceedances
Nickel	Water	Water quality dissolved criterion exceedances
Copper	Water	Water quality dissolved criterion exceedances
Contaminated Sediments	Sediment	On 303 (d) List
2-Methylnaphthalene	Sediment	ERM exceedances
4,4'-DDT	Sediment	ERM exceedances
Anthracene	Sediment	ERM exceedances
Benzo (a) Anthracene	Sediment	ERM exceedances
Benzo (a) Pyrene	Sediment	ERM exceedances
Chrysene	Sediment	ERM exceedances
Dibenzo (a,h) Anthracene	Sediment	ERM exceedances
Fluoranthene	Sediment	ERM exceedances
Fluorene	Sediment	ERM exceedances
Methoxychlor	Sediment	ESG exceedances
Phenanthrene	Sediment	ERM exceedances
Pyrene	Sediment	ERM exceedances
Zinc	Sediment	ERM exceedances
Calcium	Sediment	TIE causative toxicant (Ho 2001)

should test effluents for chronic toxicity at least quarterly to demonstrate that unmonitored pollutants or the combination of monitored and/or unmonitored pollutants are not causing instream toxicity.

Louisiana should monitor Bayou Verdine for priority organic compounds quarterly for one year to confirm no priority organic pollutants (other than 1,2-dichloroethane and phenol) exceed water quality criteria. Sampling should occur at four locations: one location above all discharges, one at the mouth of the bayou, and two equally spaced in between.

Should any other priority organic pollutants exceed applicable criteria, then TMDLs should be developed for those pollutants.

1,2-Dichloroethane

1,2-dichloroethane is a pollutant of concern because it is identified on EPA's 303(d) List, water quality data (Appendix Table B-26) indicate the pollutant is detected in 8 out of 9 samples in the Bayou, and the mean concentration of the 8 samples (32.1 μg/L) exceeds Louisiana's human health criterion of 6.8 μg/L (Appendix Table A-1).

POINT SOURCES. There are no process discharges to Bayou Verdine. PPG Industries discharges cooling water and stormwater through outfall 004, and Sasol North America and Conoco Lake

Charles Refinery discharge stormwater through multiple outfalls. Stormwater is a possible source of 1,2-Dichloroethane, but there are no data for 1,2-Dichloroethane at any outfall.

NONPOINT SOURCES. 1,2-dichloroethane has the potential to enter the bayou as a nonpoint source load, but it is unlikely there is a nonpoint source load other than from facilities discharging the pollutant. There are no data on urban nonpoint source loads of the pollutant or data that allow estimation of an urban nonpoint source load.

ATMOSPHERIC DEPOSITION. TRIS data indicate an average daily air release of 144 pounds of 1,2-dichloroethane in the four parishes surrounding the Calcasieu Estuary (Appendix Table F-5), but because of its volatility, the pollutant is likely widely dispersed so that only a small amount reaches Bayou Verdine. This amount, however, cannot be quantified.

TMDL. Based on Appendix Table E-11, the TMDL for 1,2-Dichloroethane in Bayou Verdine is 0.380 pounds per day. After subtracting a 0.076 pound per day margin of safety, the load allocation is 0.304 pounds per day.

MONITORING. All three facilities should monitor their effluents at least quarterly to determine whether there are detectable concentrations of 1,2-dichloroethane in all outfalls.

Bayou Verdine should be monitored monthly over a one-year period and at five-year intervals to ensure that the 1,2-dichloroethane human health criterion is being met as a result of this TMDL. Sampling should be done at four stations: one above both facilities, one at the mouth of Bayou Verdine, and two spaced equidistant between the upstream and downstream stations.

Phenols

Phenols are identified on EPA's 303(d) List as pollutants of concern. Water quality data (Appendix Table B-26) indicate only one sample was taken for phenol, and phenol is not detected in the sample.

POINT SOURCES. There are no process discharges to Bayou Verdine. PPG Industries discharges cooling water and stormwater through outfall 004, and Sasol North America and Conoco Lake Charles Refinery discharge stormwater through multiple outfalls. Stormwater is a possible source of phenol, but there are no data for phenol at any outfall.

NONPOINT SOURCES. Although phenol has the potential to enter the bayou as a nonpoint source load from industrial facilities, there are no data on urban nonpoint source loads of the pollutant or data that allow estimation of an urban nonpoint source load.

ATMOSPHERIC DEPOSITION. TRIS data indicate an average daily air release of 113 pounds of phenol in the four parishes surrounding the Calcasieu Estuary (Appendix Table F-5), but because of its volatility, the pollutant is likely widely dispersed so that only a small amount reaches Bayou Verdine. This amount, however, cannot be quantified.

TMDL. Based on Appendix Table E-11, the TMDL for phenol in Bayou Verdine is 5.39 pounds per day. After subtracting a 1.08 pound per day margin of safety, the load allocation is 4.31 pounds per day.

MONITORING. All three facilities should monitor their stormwater outfalls at least quarterly to determine whether there are detectable concentrations of phenol in all outfalls.

Bayou Verdine should be monitored monthly over a one-year period and at five-year intervals to ensure that the 1,2-dichloroethane human health criterion is being met as a result of this TMDL. Sampling should be done at four stations: one above both facilities, one at the mouth of Bayou Verdine, and two spaced equidistant between the upstream and downstream stations.

Nonpriority Organics

Sediment data indicate that some nonpriority PAHs and one other nonpriority organic (methoxychlor) exceed applicable sediment quality guidelines in more than 10% of samples in Bayou Verdine (Appendix Tables B-30, B-31, and B-32), but there is no evidence that the water column is impaired by nonpriority organics. The PAHs will be controlled through control of priority PAHs in this subsegment, and a TMDL for methoxychlor, based on sediment exceedances, is developed below. Therefore, there is no evidence that continuing discharges of nonpriority organics are contributing to impairment of water in this subsegment, and the subsegment should be delisted for nonpriority organics. Any possible future contribution of nonpriority organics to this subsegment would be prevented by controlling priority organic PAHs, the TMDL for methoxychlor, and the effluent toxicity of major and significant minor discharges to Bayou Verdine.

Metals

Metals are identified on EPA's 303(d) List as causing impairment in Bayou Verdine. Using the procedures described in the Methodology section, three metals are identified as pollutants of concern based on water quality dissolved criterion exceedances. The metals, copper, mercury, and nickel, are discussed in the section entitled Water Quality, below.

Contaminated Sediments

Contaminated sediments are identified on EPA's 303(d) List as causing impairment in Bayou Verdine. Organics, metals, and toxicity are also identified as components of contaminated sediments. Using the procedures described in the Methodology section, a number of organic pollutants and two metals exceed sediment quality guidelines and are likely responsible for observed sediment toxicity in Bayou Verdine. These pollutants are discussed in the following section.

MONITORING AND FOLLOW UP. The contaminated sediment TMDLs calculated in the following sections assume that pollutants identified as pollutants of concern are responsible for observed sediment toxicity. The identified pollutants, however, may not be the only sources of sediment toxicity. To ensure that the TMDLs for Bayou Verdine protect sediments, Bayou Verdine should be monitored for sediment toxicity (using methodologies specified in EPA (1995) at least once every five years at four stations: one above all dischargers, one near the mouth of the bayou, and two equidistant between the upstream and downstream stations.

Should sediment toxicity remain after the TMDLs have been implemented, Louisiana should undertake a toxicity identification evaluation (TIE) to determine the pollutant or pollutants responsible for sediment toxicity. Once pollutants have been identified, appropriate nonpoint source controls should be implemented to reduce sediment toxicity.

SEDIMENT QUALITY

PAHs

Based on EPA Superfund data (Table 8, Appendix Table B-31), concentrations of nine PAHs in sediments exceed ERMs in more than 10% of samples. These PAHs are selected as pollutants of concern (Table 6). Inclusion of NOAA's Calcasieu database (Appendix Table B-32) would add acenaphthene and fluorene to the list. See Appendix Figure C-5 for the location of all PAH exceedances.

Table 6. PAH Pollutants of Concern Based on EPA Superfund Data

Chemical	Number of Samples	Number of Detects	Minimum Detection Level (μg/kg)	Maximum Detected Value (μg/kg)	Mean of Detected Values (μg/kg)	Number > ERM	Percent > ERM
2-Methylnaphthalene	29	7	140	90,000	29,184	6	20.7
Anthracene	106	19	68	28,000	5,371	13	12.3
Benzo (a) Anthracene	115	51	6.8	63,000	8,499	30	26.1
Benzo (a) Pyrene	111	38	6.8	71,000	13,432	29	26.1
Chrysene	121	69	6.8	150,000	15,426	39	32.2
Dibenzo (a,h) Anthracene	106	14	6.8	9,800	2,904	13	12.3
Fluoranthene	116	49	6.8	49,000	7,175	15	12.9
Phenanthrene	29	9	110	280,000	67,053	5	17.2
Pyrene	128	88	6.8	190,000	19,065	48	37.5

POINT SOURCES. There are no process discharges to Bayou Verdine. PPG Industries discharges cooling water and stormwater through outfall 004, and Sasol North America and Conoco Lake Charles Refinery discharge stormwater through multiple outfalls. Stormwater is a possible source of PAHs, but there are no data for PAHs at any outfall.

NONPOINT SOURCES. While PAHs can occur as nonpoint source loads, PAHs typically are strongly bound to sediments and would be discharged only during very high runoff events. There are no data on urban nonpoint source loads of PAHs and no data that allow the estimation of possible urban nonpoint source loads.

ATMOSPHERIC DEPOSITION. The TRIS database indicates that, on average, about 20 pounds of PAHs are released to air daily in the four-parish area surrounding the Calcasieu Estuary (Appendix Table F-5). PAHs are typically released as fine particles which have very slow settling rates in the atmosphere. Thus, they are widely dispersed from sources and are unlikely to be deposited into Bayou Verdine in discernable quantities.

TMDL. The stormwater controls for all PAHs are similar, and if one target compound is removed, other PAHs will also be removed. Four of the nine PAHs causing sediment impairment (benzo (a) anthracene, benzo (a) pyrene, chrysene, and dibenzo (a,h) anthracene) have the same EPA-recommended water quality human health criterion of 0.049 μg/L (Appendix Table A-1). This criterion value is used in calculating the TMDL for Bayou Verdine.

TMDL. Based on Appendix Table E-11, the TMDL for PAHs in Bayou Verdine is 0.00274 pounds per day. After subtracting a 0.00055 pound per day margin of safety, the load allocation is 0.00219 pounds per day.

MONITORING. All three facilities should monitor their effluents at least quarterly to determine whether there are detectable concentrations of the identified PAH pollutants of concern in all outfalls.

To determine trends in sediment contamination by PAHs and the effectiveness of this TMDL, Bayou Verdine should be monitored for all identified PAH pollutants of concern in sediments at least once initially, and at five-year intervals thereafter at four stations: one station above all discharges, one station at the mouth of the bayou, and two stations equally spaced in between.

DDT

DDT is a pollutant of concern based on elevated sediment concentrations. EPA Superfund data (Appendix Table B-31) indicate that DDT is detected 5 times in 35 samples, and 11% of all samples exceed the DDT ERM. See Appendix Figure C-7 for the location of all DDT exceedances.

POINT SOURCES. There are no process discharges to Bayou Verdine. PPG Industries discharges cooling water and stormwater through outfall 004, and Sasol North America and Conoco Lake Charles Refinery discharge stormwater through multiple outfalls. Stormwater is a possible source of DDT, but there are no data for DDT at any outfall.

NONPOINT SOURCES. Urban nonpoint sources are a potential source of DDT as a result of previous soil contamination. There are, however, no data on urban nonpoint source loads of the pollutant or data that allow estimation of an urban nonpoint source load.

ATMOSPHERIC DEPOSITION. While the atmosphere may have been a source of DDT before it was banned in 1972, continued deposition of DDT is highly unlikely. There are no TRIS data indicating a recent release of DDT (Appendix Table F-5).

TMDL. The source of DDT in the sediments is likely historical use of the pesticide. DDT degrades very slowly in the environment and can persist at high concentrations for decades. No facilities in the subsegment are expected to discharge DDT. TMDL. Based on Appendix Table E-11, the TMDL for 4,4'-DDT in Bayou Verdine is 0.0000106 pounds per day. After subtracting a 0.00000212 pound per day margin of safety, the load allocation is 0.00000849 pounds per day.

MONITORING. Bayou Verdine should be monitored for DDT in sediments at least once initially, and at five-year intervals thereafter at four locations: one location above all discharges, one at the mouth of the bayou, and two equally spaced in between. The purpose of the monitoring is to determine trends in DDT contamination in sediments. In addition, existing DDT data should be examined to determine whether there is a possible DDT nonpoint (or stormwater) source or sources. Should high concentrations be located near possible sources, the sources should be monitored at least once during a high runoff event to confirm or refute the presence of DDT in the runoff. If a DDT source is confirmed, suitable nonpoint source controls should be implemented to prevent further contamination.

Methoxychlor

Methoxychlor is a pollutant of concern because concentrations in nearly 16% of sediment samples exceed the methoxychlor ESG (Appendix Table B-30).

POINT SOURCES. There are no process discharges to Bayou Verdine. PPG Industries discharges cooling water and stormwater through outfall 004, and Sasol North America and Conoco Lake Charles Refinery discharge stormwater through multiple outfalls. Stormwater is a possible source of methoxychlor, but there are no data for Methoxychlor at any outfall.

NONPOINT SOURCES. Urban nonpoint sources are a potential source of methoxychlor as a result of soil contamination. There are, however, no data on urban nonpoint source loads of the pollutant or data that allow estimation of an urban nonpoint source load.

ATMOSPHERIC DEPOSITION. There are no TRIS data indicating a recent release of methoxychlor (Appendix Table F-5).

TMDL. Based on Appendix Table E-11, the TMDL for Methoxychlor in Bayou Verdine is 0.000558 pounds per day. After subtracting a 0.000112 pound per day margin of safety, the load allocation is 0.000446 pounds per day.

MONITORING. Bayou Verdine should be monitored for methoxychlor in sediments at least once initially, and at five-year intervals thereafter at four locations: one location above all discharges, one at the mouth of the bayou, and two equally spaced in between. The purpose of the monitoring is to determine trends in methoxychlor contamination in sediments. In addition, existing methoxychlor data should be examined to determine whether there is a possible methoxychlor nonpoint (or stormwater) source or sources. Should high concentrations be located near possible sources, the sources should be monitored at least once during a high runoff event to confirm or refute the presence of methoxychlor in the runoff. If a methoxychlor source is confirmed, suitable nonpoint source controls should be implemented to prevent further contamination.

Zinc

Zinc is a pollutant of concern based on EPA Superfund sediment data (Table B-29) and sediment data in NOAA's Calcasieu database (Table B-30). Zinc sediment concentrations exceed the zinc ERM in 30 out of 103 samples. Water concentrations of zinc, however, are all below water quality criteria. See Appendix Figure C-8 for the location of all zinc exceedances.

POINT SOURCES. There are no process discharges to Bayou Verdine. PPG Industries discharges cooling water and stormwater through outfall 004, and Sasol North America and Conoco Lake Charles Refinery discharge stormwater through multiple outfalls. Stormwater is a possible source of zinc, but there are no data for zinc at any outfall.

NONPOINT SOURCES. The low-flow urban nonpoint source zinc load is estimated to be 0.0368 pounds per day (Appendix Table F-1).

ATMOSPHERIC DEPOSITION. TRIS data indicate an average daily air release of 0.0062 pounds of zinc and 1.75 pounds of zinc compounds in the four parishes surrounding the Calcasieu Estuary (Appendix Table F-5). The behavior of zinc in the atmosphere depends on the form in which it

was released, and this is not known. It is likely, however, that atmospheric zinc would not contribute an appreciable load to Bayou Verdine.

TMDL. Based on Appendix Table E-11, the TMDL for zinc in Bayou Verdine is 1.50 pounds per day. After subtracting a 0.30 pound per day margin of safety, the load allocation is 1.20 pounds per day.

MONITORING. All three facilities should monitor their effluents for dissolved and total zinc at least quarterly to determine concentrations of zinc in all outfalls.

To determine trends in sediment contamination by zinc and the effectiveness of this TMDL, zinc in sediments should be monitored at least once initially, and at five-year intervals thereafter at four stations: one station above all discharges, one station at the mouth of the bayou, and two stations equally spaced in between.

Calcium

Calcium is a pollutant of concern because of results of Toxicity Identification Evaluations (TIE) conducted by Ho (2001) and SAIC (2001). Sediment toxicity was evaluated after various treatments that removed or inactivated certain classes of pollutant compounds to determine what compounds are responsible for observed toxicity. The sample taken from lower Bayou Verdine was highly toxic even after all treatments, but filtration moderately reduced toxicity. The toxicity remaining after all treatments suggests toxicity due to ionic imbalance related to calcium (Ho 2001). Based on these results, a calcium criterion was developed for Bayou Verdine and calcium was selected as a pollutant of concern.

POINT SOURCES. There are no process discharges to Bayou Verdine. PPG Industries discharges cooling water and stormwater through outfall 004, and Sasol North America and Conoco Lake Charles Refinery discharge stormwater through multiple outfalls. Stormwater is a possible source of calcium, but there are no data for calcium at any outfall.

NONPOINT SOURCES. Calcium is a common constituent of natural waters and is undoubtedly in all runoff. There are, however, no data indicating the levels of calcium in urban runoff, nor are there data with which to estimate an urban nonpoint source load.

ATMOSPHERIC DEPOSITION. There are no data on calcium releases to the atmosphere, but it is expected that atmospheric deposition of calcium to Bayou Verdine would be very small in relation to water-borne loads.

TMDL. A calcium criterion was calculated as the mean plus three standard deviations of calcium metal concentrations in EPA's 1999-2000 Superfund monitoring data (LA 33:IX.1113.B.13). The resulting criterion is 320,000 μg/L.

TMDL. Based on Appendix Table E-11, the TMDL for calcium in Bayou Verdine is 5,950 pounds per day. After subtracting a 1,190 pound per day margin of safety, the load allocation is 4,760 pounds per day.

MONITORING AND FOLLOW UP. Monitoring for calcium is designed to develop basic information on the concentration of calcium in water, sediments, and possible sources.

All three facilities should monitor their effluents at least quarterly to determine concentrations of calcium in all outfalls.

Calcium in water should be monitored at least monthly for at least one year to establish a background water concentration. Calcium in sediments and sediment pore water should be monitored at least once and the results compared with results from a station in the estuary outside of the bayou. Should water and sediment and sediment pore water concentrations be similar to available data for other parts of the estuary, then no further monitoring should be undertaken. Otherwise, calcium should be monitored in the five-year cycle identified for other pollutants for Bayou Verdine. Monitoring should be conducted at four stations: one location above all discharges, one at the mouth of the bayou, and two equally spaced in between.

Should water and sediment concentrations be elevated above other subsegments of the estuary, then the source of the calcium be determined and suitable controls implemented.

WATER QUALITY

Copper

Copper is a pollutant of concern based on data submitted to EPA Region 6 on August 20, 2001 that contain three exceedances of the marine dissolved copper criterion in twelve samples (Appendix Table B-29). LDEQ Water Quality Network Data also includes one exceedance in four samples.

POINT SOURCES. There are no process discharges to Bayou Verdine. PPG Industries discharges cooling water and stormwater through outfall 004, and Sasol North America and Conoco Lake Charles Refinery discharge stormwater through multiple outfalls. Stormwater is a possible source of zinc, but there are no data for zinc at any outfall.

ATMOSPHERIC DEPOSITION. TRIS data indicate an average daily air release of 0.00137 pounds of copper and 1.39 pounds of copper compounds in the four parishes surrounding the Calcasieu Estuary (Appendix Table F-5). The behavior of copper in the atmosphere depends on the form in which it was released, and this is not known. It is likely, however, that atmospheric copper would not contribute an appreciable load to Bayou D'Inde.

TMDL. Based on Appendix Table E-11, the TMDL for copper in Bayou Verdine is 0.0675 pounds per day. After subtracting a 0.0135 pound per day margin of safety, the load allocation is 0.0540 pounds per day.

MONITORING. Each facility should monitor stormwater outfalls, using clean techniques, for detectable levels of copper at least quarterly.

Copper should be monitored monthly over a one-year period using clean techniques. Monitoring should occur at four stations: one station above all discharges, one station at the mouth of the bayou, and two equally spaced in between. Should all results indicate compliance with the dissolved copper chronic criterion, then monitoring could be reduced to monthly samples over a one-year period, every five years.

Mercury

Mercury is a pollutant of concern based on EPA Superfund data (Appendix Table B-26). Mercury is detected 4 times in 5 samples, and all detected values exceed Louisiana's dissolved mercury criterion. Less than 10% of sediment concentrations of mercury exceed the mercury ERM (Appendix Tables B-31 and B-32). See Appendix Figure C-3 for the location of all mercury exceedances.

POINT SOURCES. There are no process discharges to Bayou Verdine. PPG Industries discharges cooling water and stormwater through outfall 004, and Sasol North America and Conoco Lake Charles Refinery discharge stormwater through multiple outfalls. Stormwater is a possible source of mercury, but there are no data for mercury at any outfall.

NONPOINT SOURCES. Although mercury has the potential to enter the bayou as a nonpoint source load from built-up areas, there are no data on urban nonpoint source loads of the pollutant or data that allow estimation of an urban nonpoint source load.

ATMOSPHERIC DEPOSITION. TRIS data indicate an average daily air release of 0.824 pounds of mercury in the four parishes surrounding the Calcasieu Estuary (Appendix Table F-5). This value, however, is the 1996 annual release from PPG Industries, averaged over 4 years. Continuing deposition from a 1996 release is extremely unlikely.

Based on atmospheric deposition monitoring data at Lake Charles and the surface area of the bayou, the daily load of mercury from the atmosphere is 0.000000829 pounds of mercury per day (Appendix Table F-4), a level insufficient to cause water quality exceedances by itself.

TMDL. Based on Appendix Table E-11, the TMDL for mercury in Bayou Verdine is 0.000469 pounds per day. After subtracting a 0.000093 pound per day margin of safety, the load allocation is 0.000372 pounds per day.

MONITORING. All three facilities should monitor their effluents at least quarterly, using clean techniques, to determine concentrations of mercury in all stormwater outfalls.

Mercury concentrations should be monitored monthly using clean techniques for at least two years at four locations: one location above all discharges, one at the mouth of the bayou, and two equally spaced in between. Should results indicate compliance with the dissolved mercury chronic criterion, then monitoring could be reduced to one year of monthly samples every five years.

Nickel

Nickel is a pollutant of concern based on LDEQ Water Quality Network Data (Appendix Table B-28) and an assessment provided by LDEQ in comments on the Draft TMDL. Nickel is detected 3 times in 4 samples, and 2 detected values exceed Louisiana's dissolved nickel chronic criterion. Less than 10% of sediment concentrations of nickel exceed the nickel ERM (Appendix Tables B-31 and B-32). See Appendix Figure C-6 for the location of all nickel exceedances.

POINT SOURCES. There are no process discharges to Bayou Verdine. PPG Industries discharges cooling water and stormwater through outfall 004, and Sasol North America and Conoco Lake Charles Refinery discharge stormwater through multiple outfalls. Stormwater is a possible source of nickel, but there are no data for nickel at any outfall.

NONPOINT SOURCES. Although nickel has the potential to enter the bayou as an urban nonpoint source load, there are no data on urban nonpoint source loads of the pollutant or data that allow calculation of an urban nonpoint source load.

ATMOSPHERIC DEPOSITION. TRIS data indicate an average daily air release of 0.313 pounds of nickel in the four parishes surrounding the Calcasieu Estuary (Appendix Table F-5). The behavior of nickel in the atmosphere depends on the form in which it was released, and this is not known. It is likely, however, that atmospheric nickel would not contribute an appreciable load to Bayou Verdine.

TMDL. Based on Appendix Table E-11, the TMDL for Nickel in Bayou Verdine is 0.153 pounds per day. After subtracting a 0.031 pound per day margin of safety, the load allocation is 0.122 pounds per day.

MONITORING. All three facilities should monitor their effluents at least quarterly, using clean techniques, to determine concentrations of nickel in all outfalls.

Nickel should be monitored monthly over a one-year period using clean techniques. Monitoring should occur at four stations: one station above all discharges, one station at the mouth of the bayou, and two equally spaced in between. Should all results indicate compliance with the dissolved nickel chronic criterion, then monitoring could be reduced to monthly samples over a one-year period, every five years.

TMDLS FOR SUBSEGMENT 030901, BAYOU D'INDE

Bayou D'Inde, subsegment 030901 of the Calcasieu River Basin, lies in Calcasieu Parish, in the northern portion of the Calcasieu Estuary, southwest of the city of Lake Charles. Bayou D'Inde's headwaters originate in the western part of Sulphur, Louisiana and flow 9 miles primarily east-southeast through heavy commercial and industrialized areas. It empties into the Calcasieu Ship Channel just west of Prien Lake. See Figure 3 for the location of subsegment 030901.

The Bayou D'Inde watershed covers approximately 21,000 acres. The surface elevation in the area of the bayou averages about 10 feet above mean sea level (msl). The area surrounding Bayou D'Inde lies within the 100-year flood plain of the Calcasieu River Basin (PRC 1994). The bayou ranges from 80 to 150 feet wide and up to 16 feet deep. Floodwater frequently covers soils surrounding the bayou to depths of 1 to 6 feet for periods of up to 10 days, mostly in winter and spring (PRC 1993). Its headwaters are fresh and mix with brackish water of the Calcasieu Estuary to the south.

According to the USFWS National Wetland Inventory Map, the upper reaches of Bayou D'Inde are riverine and permanently flooded. This portion of the bayou has water depths ranging from 1.2 to 2.1 meters (m) (approximately 4 to 7 feet) and is not tidally influenced. The lower reaches of the bayou are tidally influenced, with up to three inches of daily water level fluctuation. Channel depths range up to 5 m (16 feet).

The land around Bayou D'Inde includes undeveloped wooded marsh land, rural residential, commercial, and heavy industrial property. Rural residential and undeveloped woodland areas border the bayou northwest upstream of the industrial area. Heavy industry dominates the middle and southern reaches of Bayou D'Inde on both sides.

Subsegment 030901 incorporates only a portion of the Bayou D'Inde AOC because the confluence of Bayou D'Inde with the Calcasieu Ship Channel, adjacent to the Lower Calcasieu River AOC, has been incorporated by subsegment 030301 of the Calcasieu River Basin. This report includes the submerged areas and bayou channel up to the boundary of the ship channel as part of Bayou D'Inde.

Designated Uses

LDEQ has designated Bayou D'Inde for primary contact recreation, secondary contact recreation, and propagation of fish and wildlife (LAC 33:IX.1123.A, Table 3). It is not a drinking water source. Bayou D'Inde currently supports recreational fishing and has several delineated wetlands that are considered sensitive environments.

Pollutants of Concern

EPA's court-ordered 303(d) List identifies priority organics, nonpriority organics, other inorganics, and contaminated sediments for Bayou D'Inde. Four priority organic compounds are listed (tetrachloroethane, hexachlorobutadiene, bromoform, and PCBs), and copper is also listed.

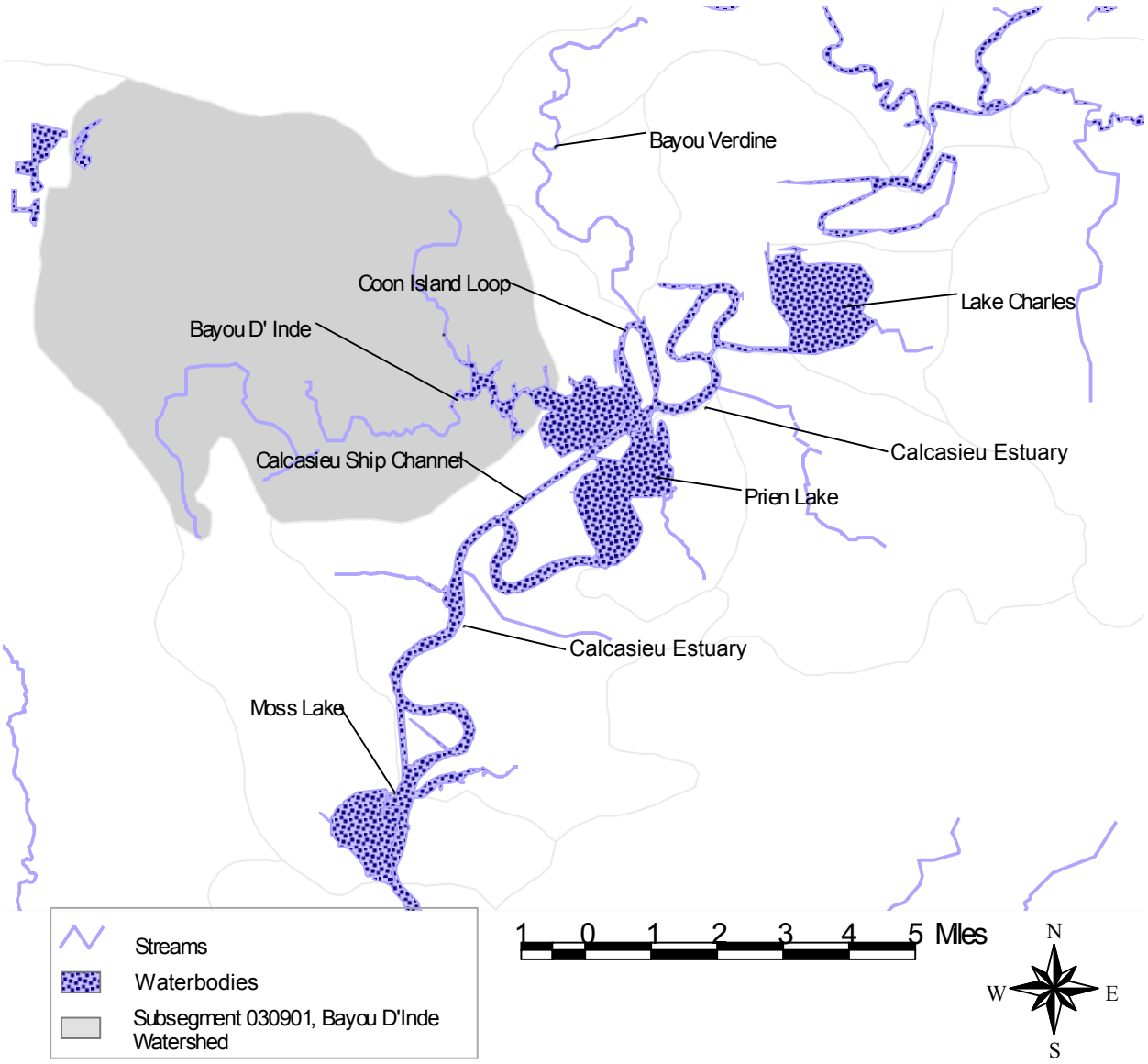

Figure 3. Location of Subsegment 030901, Bayou D'Inde

Using the procedures described in the Methodology section, there are seven pollutants and four pollutant groups of concern for Bayou D'Inde (Table 7). Five are identified on EPA's court-ordered 303(d) List (Table 1), and two of these pollutants are the subject of a fish consumption and swimming advisory in the bayou. An additional pollutant that is the subject of a fish advisory is not identified on the 303(d) List. One additional pollutants are pollutants of concern because of sediment quality guideline exceedances.

Table 7. Pollutants of Concern for Bayou D'Inde

Pollutant	Medium	Basis for Selection
Priority Organics	Water	On 303(d) List
Nonpriority Organics	Water	On 303(d) List
Hexachlorobutadiene	Fish tissue	On 303(d) List, Fish Advisory
PCBs	Fish tissue	On 303(d) List, Fish Advisory
Tetrachloroethane	Water	On 303(d) List
Bromoform	Water	On 303(d) List
Copper	Water	On 303(d) List, Water quality dissolved criterion exceedances
Other Inorganics	Water	On 303(d) List
Contaminated sediments	Sediment	On 303(d) List
Hexachlorobenzene	Water	Fish Advisory
Mercury	Water & Sediment	ERM exceedances

TMDLs for these pollutants are developed in the following subsections. The subsections are organized by the basis for selection as pollutants of concern.

303(D) LIST

Priority Organics

Hexachlorobutadiene, PCBs, tetrachloroethane, and bromoform are priority organic pollutants specifically identified on EPA's 303(d) List, and TMDLs for these pollutants are developed below. Using the procedures described in the Methodology section, pollutants of concern within general categories are determined using concentration data. No other priority organic pollutants exceed water quality criteria (Appendix Table B-35).

MONITORING AND FOLLOW UP. Consistent with EPA Region 6's Policy for Third Round NPDES Permitting (EPA 1992a) and Post Third Round Permit Implementation Strategy (EPA 1992b) or the most recent revisions thereof, all major and significant minor dischargers to Bayou D'Inde should test effluents for chronic toxicity at least quarterly to demonstrate that unmonitored pollutants or the combination of monitored and/or unmonitored pollutants are not causing instream toxicity.

Bayou D'Inde should be monitored for priority organic compounds quarterly for one year. Samples should be taken in the bayou at four stations: above Firestone Polymers, at the mouth, and at two stations equidistant between these stations.

Should any other priority organic pollutants exceed applicable criteria, then TMDLs should be developed for those pollutants.

Nonpriority Organics

Sediment data indicate that no nonpriority organic chemicals exceed applicable sediment quality guidelines in more than 10% of samples in Bayou D'Inde (Appendix Tables B-39, B-40, and B-41), and recent data (Appendix Table B-40) show fewer exceedances than older data (Appendix Table B-41). Therefore, there is no evidence that continuing discharges of nonpriority organics

are contributing to impairment in this subsegment, and the subsegment should be delisted for nonpriority organics. Any possible future contribution of nonpriority organics to this subsegment would be prevented by controlling the effluent toxicity of major and significant minor dischargers to Bayou D'Inde.

Hexachlorobutadiene

Hexachlorobutadiene is a pollutant of concern because it is listed on EPA's court-ordered 303(d) List and is identified in a fish consumption and swimming advisory for Bayou D'Inde. Hexachlorobutadiene is not detected in Bayou D'Inde water, but the minimum detection level for the 6 water samples is 9 µg/L, well above Louisiana's human health criterion for hexachlorobutadiene of 0.11 µg/L (Appendix Table A-1). Hexachlorobutadiene has no ESG or ERM, so available sediment data are not analyzed for this document. The most recent fish tissue data for Bayou D'Inde appear in Appendix Table D-4.

POINT SOURCES. Four of the facilities that discharge to Bayou D'Inde and are reasonably expected to discharge hexachlorobutadiene (Appendix Table E-5) have permit limits for the pollutant (Appendix Table E-6). Of these facilities, only PPG Industries has detected hexachlorobutadiene in effluents (Appendix Table E-7, Table 8). Stormwater is a possible source of hexachlorobutadiene, but there are no data for the pollutant at any stormwater outfall.

Table 8. Existing and Permitted Loads of Hexachlorobutadiene, Bayou D'Inde

Facility	NPDES Number	Mean Load (pounds/day)	Maximum Load (pounds/day)	Average Permitted Load (pounds/day)	Maximum Permitted Load (pounds/day)
PPG Industries, Inc.	LA0000761	0.0339	0.475	0.0675	0.203
Certainteed Corporation	LA0041025	ND	ND	0.600	1.610
Equistar Chemical	LA0069850	ND	ND	0.017	0.042
Westlake Polymers-Lake Charles	LA0071382	ND	ND	0.010	0.023
Total		0.0339	0.475	0.6945	1.878

ND = no data or not detected and reported as zero

NONPOINT SOURCES. Although hexachlorobutadiene has the potential to enter the bayou as an industrial nonpoint source load, there are no data on urban nonpoint source loads of the pollutant or data that allow estimation of an urban nonpoint source load.

ATMOSPHERIC DEPOSITION. TRIS data indicate an average daily air release of 1.72 pounds of hexachlorobutadiene in the four parishes surrounding the Calcasieu Estuary (Appendix Table F-5). This release is probably widely dispersed, and a very small portion of the release is likely deposited in Bayou D'Inde.

TMDL. Using the procedures described in the Methodology section, the assimilative capacity of Bayou D'Inde (less a 20% margin of error) is 0.166 pounds per day (Table E-11). Wasteload allocations for each facility appear in Appendix Table E-14 and Table 9. PPG Industries and Westlake Polymers-Lake Charles have a calculated wasteload allocation that is higher than their existing permit limits, so the existing limits would apply. Certainteed Corporation and Equistar

Chemical both have wasteload allocations that are more stringent than their existing permit limits.

Table 9. TMDL for Hexachlorobutadiene, Bayou D'Inde

Facility	Wasteload Allocation (pounds per day)	Load Allocation (pounds per day)	Margin of Safety (pounds per day)	TMDL (pounds per day)
PPG Industries, Inc.	0.13200	-	-	-
Certainteed Corporation	0.00851	-	-	-
Equistar Chemical	0.01240	-	-	-
West Lake Polymers-Lake Charles	0.01300	-	-	-
Total	0.16591	0.00009	0.04150	0.20750

Note: The wasteload allocation is an average monthly allocation

MONITORING. Each facility should monitor process effluents at least quarterly, using the most sensitive approved analytical methods, to demonstrate compliance with these wasteload allocations. Each facility should monitor stormwater outfalls for detectable levels of hexachlorobutadiene at least quarterly.

Fish tissues should continue to be monitored for hexachlorobutadiene on at least a biennial basis to ensure hexachlorobutadiene concentrations remain low as a result of this TMDL.

PCBs

PCBs are pollutants of concern because they are identified on the 303(d) List and are the subject of a fish consumption and swimming advisory in Bayou D'Inde. Concentrations of Aroclor 1254 are higher in red drum from Bayou D'Inde than in other parts of the estuary (Tables D-7 and D-8). High concentrations of PCBs in fish tissue appear sporadically throughout the estuary. PCBs are detected once in the water column (out of 27 samples), but the detection level used is considerably higher than Louisiana's human health criterion for PCBs of 0.00001 µg/L. It is expected that average PCB concentrations in the water would exceed the criterion, although it is not possible to measure PCBs at such low concentrations with conventional methods. PCBs are not detected in sediments in 21 samples (Appendix Table B-41).

POINT SOURCES. Four facilities that discharge to Bayou D'Inde are reasonably expected to discharge PCBs (Appendix Table E-5), but none have permit limits for the pollutant (Appendix Table E-6). Stormwater is a possible source of PCBs, but there are no data for the pollutant at any process or stormwater outfall.

NONPOINT SOURCES. There is a possibility that PCBs are discharged in stormwater or other urban nonpoint source runoff as a result of previous spills or accidents involving PCBs.

ATMOSPHERIC DEPOSITION. TRIS does not contain any data that PCBs have been released to air in the vicinity of Bayou D'Inde (Appendix Table F-5). Unreported releases may have occurred as the result of accidents. The atmosphere is not a likely source of PCBs to the bayou.

TMDL. Using the procedures described in the Methodology section, the assimilative capacity load for Bayou D'Inde (less a 20% margin of error) is 0.0000156 pounds per day (Table E-11). Wasteload allocations for each facility appear in Appendix Table E-14 and Table 10.

Table 10. TMDL for PCBs, Bayou D'Inde

Facility	Wasteload Allocation (pounds per day)	Load Allocation (pounds per day)	Margin of Safety (pounds per day)	TMDL (pounds per day)
PPG Industries, Inc.	0.000012400	-	-	-
Certainteed Corporation	0.000000799	-	-	-
Equistar Chemical	0.000001170	-	-	-
West Lake Polymers-Lake Charles	0.000001220	-	-	-
Total	0.000015589	0.000000017	0.000003880	0.000019486

Note: The wasteload allocation is an average monthly allocation

MONITORING AND FOLLOW UP. All dischargers should monitor process effluents, using the most sensitive approved methods, at least quarterly to demonstrate compliance with these wasteload allocations. Each facility should monitor stormwater outfalls for detectable levels of PCBs at least quarterly.

Fish tissues should continue to be monitored for PCBs on at least a biennial basis to ensure PCB concentrations decline as a result of this TMDL.

Fish tissue data appear to be the most reliable method of determining potential sources of PCBs. Water and sediment concentrations of PCBs are sufficiently low that conventional analytical methods cannot detect them. Fish data, however, suggest that there is either contaminated sediment or contaminated runoff in lower Bayou D'Inde. A spatially intense monitoring program for PCB concentrations in fish in lower Bayou D'Inde should be undertaken in an effort to isolate sources. Once sources are identified, appropriate actions (e.g., remediation, nonpoint source controls, revised wasteload allocations) should be taken to reduce the sources to acceptable levels.

Tetrachloroethane

Tetrachloroethane is a pollutant of concern because it is on EPA's 303(d) List (Table 1). 1,1,2,2-tetrachloroethane is not detected in water (Appendix Table B-35) although the minimum detection level is greater than Louisiana's human health criterion of 1.8 µg/L (the detection limit is sufficiently low, however, to determine exceedances of the acute and chronic aquatic life criteria). Similarly, tetrachloroethane is not detected in sediments (Appendix Table B-39).

POINT SOURCES. None of the four facilities that are reasonably expected to discharge tetrachloroethane to Bayou D'Inde (Appendix Table E-5) are permitted to discharge the pollutant (Appendix Table E-6), and there are no discharge data for any outfall in the waterbody (Appendix Table E-7).

NONPOINT SOURCES. Although tetrachloroethane has the potential to enter the bayou as an industrial nonpoint source load, there are no data on urban nonpoint source loads of the pollutant and no data that allow calculation of an urban nonpoint source load.

ATMOSPHERIC DEPOSITION. TRIS data indicate an average daily air release of 12.6 pounds of tetrachloroethane in the four parishes surrounding the Calcasieu Estuary (Appendix Table F-5). This release is probably widely dispersed, and a very small portion of the release is likely deposited in Bayou D'Inde.

TMDL. Using the procedures described in the Methodology section, the assimilative capacity of Bayou D'Inde (less a 20% margin of error) is 2.81 pounds per day (Table E-11). Wasteload allocations for each facility appear in Appendix Table E-14 and Table 11.

Table 11. TMDL for Tetrachloroethane, Bayou D'Inde

Facility	Wasteload Allocation (pounds per day)	Load Allocation (pounds per day)	Margin of Safety (pounds per day)	TMDL (pounds per day)
PPG Industries, Inc.	2.230	-	-	-
Certainteed Corporation	0.144	-	-	-
Equistar Chemical	0.210			
West Lake Polymers-Lake Charles	0.220			
Total	2.804	0.006	0.703	3.513

Note: The wasteload allocation is an average monthly allocation

MONITORING. Each facility should monitor process effluents at least quarterly, using the most sensitive approved analytical methods, to demonstrate compliance with these wasteload allocations. Each facility should monitor stormwater outfalls for detectable levels of tetrachloroethane at least quarterly.

Tetrachloroethane should be monitored in Bayou D'Inde water at least quarterly for one year, and quarterly at five-year intervals thereafter, to ensure detectable levels of tetrachloroethane are not occurring. Samples should be taken in the bayou at four stations: one station above the Firestone Polymers discharge, one station at the mouth, and at two stations equidistant between these stations.

Bromoform

Bromoform is a pollutant of concern because it is on EPA's court-ordered 303(d) List (Table 1). Bromoform is detected in water (Appendix Table B-35), but concentrations do not exceed Louisiana's human health water quality criterion of 34.7 µg/L. Bromoform is not detected in sediments (Appendix Table B-39).

POINT SOURCES. One facility of the four that are reasonably expected to discharge bromoform to the bayou is permitted to discharge bromoform (Appendix Table E-5, Table 12).

Table 12. Existing and Permitted Loads of Bromoform, Bayou D'Inde

Facility	NPDES Number	Mean Load (pounds/day)	Maximum Load (pounds/day)	Average Permitted Load (pounds/day)	Maximum Permitted Load (pounds/day)
PPG Industries, Inc.	LA0000761	10	32	41	81
Certainteed Corporation	LA0041025	-	-	-	-
Equistar Chemical	LA0069850	-	-	-	-
West Lake Polymers-Lake Charles	LA0071382	-	-	-	
Total		10	32	41	81

NONPOINT SOURCES. Although bromoform has the potential to enter the bayou as a nonpoint source load from industrial sources, there are no data on urban nonpoint source loads of the pollutant or data that allow estimation of an urban nonpoint source load.

ATMOSPHERIC DEPOSITION. TRIS data indicate bromoform has not been released to air in the four parishes surrounding the Calcasieu Estuary (Appendix Table F-5).

TMDL. Using the procedures described in the Methodology section, the assimilative capacity of Bayou D'Inde (less a 20% margin of error) is 54.1 pounds per day (Table E-11). Wasteload allocations for each facility appear in Appendix Table E-14 and Table 13. PPG Industries' existing limit is more stringent than the wasteload allocation, so the existing limit still applies.

Table 13. TMDL for Bromoform, Bayou D'Inde

Facility	Wasteload Allocation (pounds per day)	Load Allocation (pounds per day)	Margin of Safety (pounds per day)	TMDL (pounds per day)
PPG Industries, Inc.	43.00	-	-	-
Certainteed Corporation	2.77	-	-	-
Equistar Chemical	4.05			
West Lake Polymers-Lake Charles	4.24			
Total	54.06	0.04	13.53	67.63

Note: The wasteload allocation is an average monthly allocation

MONITORING. Each facility should monitor process effluents at least quarterly, using the most sensitive approved analytical methods, to demonstrate compliance with these wasteload allocations. Each facility should monitor stormwater outfalls for detectable levels of tetrachloroethane at least quarterly.

Bromoform in water should be monitored at least quarterly over one year and quarterly over one year at five year increments thereafter. Samples should be taken in the lower bayou at four stations: above the Firestone discharge, at the mouth, and at two stations equidistant between these stations. The purpose of the monitoring is to ensure that Louisiana's human health criterion for bromoform is being attained as a result of this TMDL.

Copper

Copper is a pollutant of concern because it is identified on EPA's 303(d) List and water concentrations exceed Louisiana's acute dissolved copper aquatic life criterion 26 times in 36 samples (Appendix Table B-35). Sediment concentrations of copper exceed the copper ERM in 24 out of 292 samples (Appendix Tables B-40 and B-41), less than 10% of all samples. See Appendix Figure C-4 for the location of all copper exceedances.

POINT SOURCES. Only one of the eleven facilities that are reasonably expected to discharge copper to the bayou are permitted to discharge copper (Appendix Table E-17, Table 14).

Table 14. Existing and Permitted Loads of Copper, Bayou D'Inde

Facility	NPDES Number	Mean Load (pounds/day)	Maximum Load (pounds/day)	Average Permitted Load (pounds/day)	Maximum Permitted Load (pounds/day)
PPG Industries, Inc.	LA0000761	5.8	100.7	28	73.2
Firestone Polymers	LA0003824	-	-	-	-
Citgo Petroleum Corporation	LA0005941	-	-	-	-
Certainteed Corporation	LA0041025	-	-	-	-
Air Liquide	LA0053708	-	-	-	-
Equistar Chemical	LA0069850	-	-	-	-
West Lake Polymers-Lake Charles	LA0071382	-	-	-	-
Praxair Inc.	LA0100099	-	-	-	-
Cetco	LA0101869	-	-	-	-
W-H Holdings Inc.	LA0105155	-	-	-	-
Denmar Enterprises	LA0108596	-	-	-	-
Total		5.8	100.7	28	73.2

NONPOINT SOURCES. The low-flow urban nonpoint source load for copper is estimated to be 0.00637 pounds per day (Appendix Table F-1).

ATMOSPHERIC DEPOSITION. TRIS data indicate an average daily air release of 0.00137 pounds of copper and 1.39 pounds of copper compounds in the four parishes surrounding the Calcasieu Estuary (Appendix Table F-5). The behavior of copper in the atmosphere depends on the form in which it was released, and this is not known. It is likely, however, that atmospheric copper would not contribute an appreciable load to Bayou D'Inde.

TMDL. Using the procedures described in the Methodology section, the assimilative capacity of Bayou D'Inde (less a 20% margin of error) is 1.89 pounds per day (Table E-11). Wasteload allocations for each facility appear in Appendix Table E-14 and Table 15. PPG Industries' existing limit is less stringent than the wasteload allocation, so the wasteload allocation applies.

Table 15. TMDL for Copper, Bayou D'Inde

Facility	Wasteload Allocation (pounds/day)	Load Allocation (pounds/day)	Margin of Safety (pounds/day)	TMDL (pounds/day)
PPG Industries, Inc.	0.7300000			
Firestone Polymers	0.0968000			
Citgo Petroleum Corporation	0.1530000			
Certainteed Corporation	0.0800000			
Air Liquide	0.0022900			
Equistar Chemical	0.1090000			
West Lake Polymers-Lake Charles	0.1100000			
Praxair Inc.	0.0037300			
Cetco	0.0000396			
W-H Holdings Inc.	0.0001910			
Denmar Enterprises	0.0000305			
Total	1.285081	0.604919	0.472500	2.362500

Note: The wasteload allocation is a maximum daily allocation

MONITORING. Each facility should monitor process effluents for copper at least quarterly, using clean techniques, to demonstrate compliance with these wasteload allocations. Each facility should monitor stormwater outfalls, using clean techniques, for detectable levels of copper at least quarterly.

Copper concentrations in Bayou D'Inde should be monitored using clean techniques monthly for one year and monthly for one year at a five year interval thereafter. Sediment concentrations of copper should be monitored once in each year water samples are taken. Samples should be taken at four stations: above Firestone Polymers, at the mouth, and at two stations equidistant between these stations. The purpose of the monitoring is to determine whether this TMDL is resulting in compliance with water quality criteria and protecting sediments.

Other Inorganics

Other inorganics are on EPA's 303(d) List. Based on Louisiana Water Quality Network Data and EPA Superfund data, there are no other inorganic toxic pollutants with concentrations outside the normal range of concentrations for estuarine waters. Similarly, no facility discharges other inorganic toxic pollutants in concentrations expected to cause concentrations in receiving water in concentrations outside the normal range of concentrations for estuarine waters. Other inorganics would also be protected by whole effluent toxicity testing for major and significant minor discharges to this subsegment. Therefore, other inorganics should be delisted for Bayou D'Inde.

Contaminated Sediments

Sediment concentrations of one metal, mercury, exceed sediment quality guidelines in more than 10% of samples. Mercury may contribute to observed sediment toxicity in Bayou D'Inde. Mercury is addressed below under Water Quality Criteria.

A number of PAHs exceed ERMs in this subsegment, but all exceed these guidelines in less than 10% of samples, and the more recent Superfund data indicate fewer exceedances (Appendix Table B-40) than the older NOAA data (Appendix Table B-41). No other organic compounds exceed ERMs in more than 10% of samples. So no sediment organic contaminants of concern are identified for Bayou D'Inde.

MONITORING AND FOLLOW UP. The contaminated sediment TMDL calculated below assume that the pollutant identified as a pollutant of concern is responsible for observed sediment toxicity. The identified pollutant, however, may not be the only sources of sediment toxicity. To ensure that the TMDLs for Bayou D'Inde protect sediments, Louisiana should monitor sediment toxicity (using methodologies specified in EPA (1995) at least once every five years at four stations: one above all dischargers, one near the mouth of the bayou, and two equidistant between the upstream and downstream stations.

Should sediment toxicity remain after the TMDLs have been implemented, a toxicity identification evaluation (TIE) should be done to determine the pollutant or pollutants responsible for sediment toxicity. Once pollutants have been identified, appropriate point source or nonpoint source controls should be implemented to reduce sediment toxicity.

FISH ADVISORY

Hexachlorobenzene

Hexachlorobenzene is a pollutant of concern because it is listed on EPA's court-ordered 303(d) List (Table 1) and is listed for a fish consumption and swimming advisory for Bayou D'Inde. Hexachlorobenzene has no ESG or ERM, so available sediment data are not analyzed for this document. The most recent fish tissue data (Appendix Tables D-1 and D-2) indicate the pollutant has the highest concentrations in blue crab and white shrimp taken from Bayou D'Inde, but concentrations are at or near acceptable levels.

POINT SOURCES. Four of the facilities that discharge to Bayou D'Inde and are reasonably expected to discharge hexachlorobutadiene (Appendix Table E-5) have permit limits for the pollutant (Appendix Table E-6). Of these facilities, only PPG Industries has detected hexachlorobutadiene in effluents (Appendix Table E-7, Table 16). Stormwater is a possible source of hexachlorobutadiene, but there are no data for the pollutant at any stormwater outfall.

Table 16. Existing and Permitted Loads of Hexachlorobenzene, Bayou D'Inde

Facility	NPDES Number	Mean Load (pounds/day)	Maximum Load (pounds/day)	Average Permitted Load (pounds/day)	Maximum Permitted Load (pounds/day)
PPG Industries, Inc.	LA0000761	0.001232	0.044	0.0001	0.00034
Certainteed Corporation	LA0041025	ND	ND	0.6	1.61
Equistar Chemical	LA0069850	ND	ND	0.0001	0.0003
Westlake Polymers-Lake Charles	LA0071382	ND	ND	0.00007	0.00016
Total		0.001232	0.044	0.60027	1.6108

NONPOINT SOURCES. Although hexachlorobenzene has the potential to enter the bayou as an industrial nonpoint source load, there are no data on urban nonpoint source loads of the pollutant or data that allow calculation of an urban nonpoint source load.

ATMOSPHERIC DEPOSITION. TRIS data indicate an average daily air release of 0.13 pounds of hexachlorobenzene in the four parishes surrounding the Calcasieu Estuary (Appendix Table F-5). This release is probably widely dispersed, and a very small portion of the release is likely deposited in Bayou D'Inde.

TMDL. Using the procedures described in the Methodology section, the assimilative capacity of Bayou D'Inde (less a 20% margin of error) is 0.00039 pounds per day (Table E-11). Wasteload allocations for each facility appear in Appendix Table E-14 and Table 17. All facilities have permit limits that are less stringent than the wasteload allocation, so the wasteload allocations apply.

Table 17. TMDL for Hexachlorobenzene, Bayou D'Inde

Facility	Wasteload Allocation (pounds per day)	Load Allocation (pounds per day)	Margin of Safety (pounds per day)	TMDL (pounds per day)
PPG Industries, Inc.	0.000310			
Certainteed Corporation	0.0000200			
Equistar Chemical	0.0000291			
West Lake Polymers-Lake Charles	0.0000305			
Total	0.000390	0.000001	0.000097	0.000488

Note: The wasteload allocation is an average monthly allocation

MONITORING. Each facility should monitor process effluents at least quarterly, using the most sensitive approved analytical methods, to demonstrate compliance with these wasteload allocations. Each facility should monitor stormwater outfalls for detectable levels of hexachlorobenzene at least quarterly.

Fish tissues should continue to be monitored for hexachlorobenzene on at least a biennial basis to ensure hexachlorobenzene concentrations decline as a result of this TMDL.

SEDIMENT QUALITY

Mercury

Mercury is a pollutant of concern because sediment metals are on the court-ordered 303(d) List and 63 of 139 sediment concentrations (45%) exceed the mercury ERM (Appendix Table B-40). 2 of 12 samples for dissolved mercury also exceed Louisiana's chronic aquatic life criterion (Appendix Table B-35). See Appendix Figure C-3 for the location of all mercury exceedances. Fish tissue mercury concentrations are generally higher in Bayou D'Inde for all species than in the Calcasieu Estuary and Ship Channel (Appendix Tables D-10 and D-11).

SAIC (2001) conducted a Toxicity Identification Evaluation for Bayou D'Inde sediments. In the study, sediment toxicity was evaluated after various treatments that removed or inactivated certain classes of pollutant compounds to determine what compounds are responsible for observed toxicity. Both samples taken from Bayou D'Inde had initial toxicity reduced by filtration, suggesting that toxicity is associated with pollutants attached to particles. The middle bayou sample had a greater reduction than the lower bayou sample. Both samples also had reduced toxicity with thiosulfate addition, suggesting that metals such as mercury, copper, cadmium, and silver might be responsible for toxicity. Organics removal had a small effect on the toxicity of both samples. These results are consistent with a sediment that is contaminated with a metal such as mercury, but other pollutants that cause toxicity cannot be ruled out.

POINT SOURCES. Only one of the eleven facilities that are reasonably expected to discharge mercury to the bayou (Appendix Table E-5) is permitted to discharge mercury (Table 30, Appendix Table E-6). All of the other facilities are expected to discharge mercury at low levels. PPG Industries is the only facility with mercury load data (Appendix Table E-7, Table 18).

Table 18. Existing and Permitted Loads of Mercury, Bayou D'Inde

Facility	NPDES Number	Mean Load (pounds/day)	Maximum Load (pounds/day)	Average Permitted Load (pounds/day)	Maximum Permitted Load (pounds/day)
PPG Industries, Inc.	LA0000761	0.0219	0.56	0.13	0.30
Firestone Polymers	LA0003824	-	-	-	-
Citgo Petroleum Corporation	LA0005941	-	-	-	-
Certainteed Corporation	LA0041025	-	-	-	-
Air Liquide	LA0053708	-	-	-	-
Equistar Chemical	LA0069850	-	-	-	-
West Lake Polymers-Lake Charles	LA0071382	-	-	-	-
Praxair Inc.	LA0100099	-	-	-	-
Cetco	LA0101869	-	-	-	-
W-H Holdings Inc.	LA0105155	-	-	-	-
Denmar Enterprises	LA0108596	-	-	-	-
Total		0.0219	0.56	0.13	0.30

NONPOINT SOURCES. Although mercury has the potential to enter the bayou as a nonpoint source load, there are no data on urban nonpoint source loads of the pollutant or data that allow calculation of an urban nonpoint source load.

ATMOSPHERIC DEPOSITION. TRIS data indicate an average daily air release of 0.0151 pounds of mercury in the four parishes surrounding the Calcasieu Estuary (Appendix Table F-5). This load is based on an annual release from PPG Industries in 1996.

Based on atmospheric deposition monitoring data at Lake Charles and the surface area of the bayou, the daily load of mercury from the atmosphere is 0.0000174 pounds of mercury per day (Appendix Table F-4).

TMDL. Using the procedures described in the Methodology section, the assimilative capacity of Bayou D'Inde (less a 20% margin of error) is 0.013 pounds per day (Table E-11). Wasteload allocations for each facility appear in Appendix Table E-14 and Table 19.

Table 19. TMDL for Mercury, Bayou D'Inde

Facility	Wasteload Allocation (pounds/day)	Load Allocation (pounds/day)	Margin of Safety (pounds/day)	TMDL (pounds/day)
PPG Industries, Inc.	0.00854			
Firestone Polymers	0.000665			
Citgo Petroleum Corporation	0.00157			
Certainteed Corporation	0.00055			
Air Liquide	0.0000157			
Equistar Chemical	0.000804			
West Lake Polymers-Lake Charles	0.000841			
Praxair Inc.	0.0000257			
Cetco	0.000000272			
W-H Holdings Inc.	0.00000131			
Denmar Enterprises	0.00000021			
Total	0.0130	0.0000168	0.00322	0.0163

Note: The wasteload allocation is a maximum daily allocation.

MONITORING. Each facility should monitor dissolved and total mercury in process effluents at least quarterly, using clean techniques, to demonstrate compliance with these wasteload allocations. Each facility should monitor stormwater outfalls for detectable levels of mercury at least quarterly.

Total and dissolved mercury concentrations should be monitored in Bayou D'Inde, using clean techniques, monthly for one year and monthly for one year at a five year interval thereafter. Sediment concentrations of mercury should be monitored once in each year water samples are taken. Samples should be taken at four stations: above Firestone Polymers, at the mouth, and at two stations equidistant between these stations. The purpose of the monitoring is to determine whether this TMDL is allowing water quality criteria to be achieved and is protecting sediments.

TMDLS FOR SUBSEGMENT 030305, CONTRABAND BAYOU

Contraband Bayou, subsegment 030305, is a portion of the Calcasieu Estuary located south of Lake Charles, directly east of Prien Lake, subsegment 030303. The bayou flows from the east, entering the Upper Calcasieu River between the Clooney and Coon Island Loops. See Figure 4 for the location of subsegment 030305.

The Bayou drainage basin encompasses the city of Prien in Calcasieu Parish and extends northerly towards the city of Lake Charles. The 9,770 acre drainage basin area is triangularly shaped, approximately 5 miles to a side. The bayou is approximately 4 miles long.

The first mile of Contraband Bayou from the confluence with the Upper Calcasieu River overlaps the Upper Calcasieu River Area of Concern (AOC).

Designated Uses

LDEQ designates Contraband Bayou for primary contact recreation, secondary contact recreation, and propagation of fish and wildlife (LAC 33:IX.1123.A, Table 3). The bayou is not a source of drinking water. The Calcasieu Estuary also supports recreational and commercial fishing and has several delineated wetlands that are considered sensitive environments.

Pollutants of Concern

Priority organics are identified on EPA's court-ordered 303(d) List as causing impairment of Contraband Bayou water, but no specific pollutants are listed.

Using the procedures specified in the Methodology section, there are no organic pollutants that exceed Louisiana's water quality criteria or EPA's recommended water quality criteria (Table B-20). Similarly, there are no pollutants in sediments with concentrations that exceed ESG or ERM guidelines (Appendix Tables B-24 and B-25). Actions to take regarding the listing for priority organics are presented below.

Priority Organics

There are no known or suspected discharges of priority organics to Contraband Bayou. Sediment data indicate no ESG or ERM exceedances for priority organics (Appendix Tables B-24 and B-25). There is no evidence that priority organics are causing impairment of this subsegment. Therefore, this subsegment should be delisted for priority organics. Any possible future impairment of this subsegment by priority organics would be prevented by controlling the effluent toxicity of nearby major and significant minor dischargers that do not discharge directly to Lake Charles.

MONITORING. Consistent with EPA Region 6's Policy for Third Round NPDES Permitting (EPA 1992a) and Post Third Round Permit Implementation Strategy (EPA 1992b) or the most recent

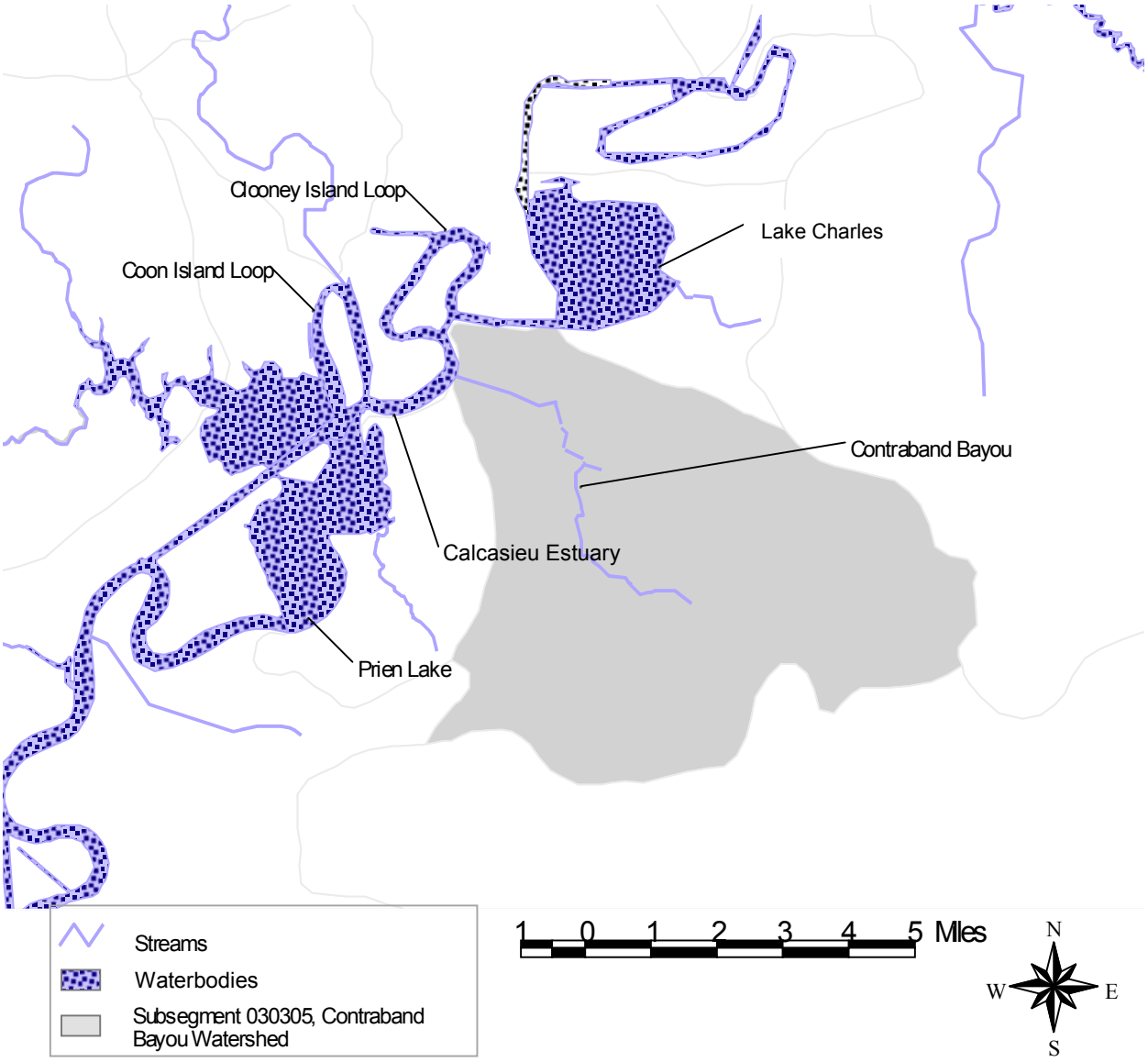

Figure 4. Location of Subsegment 030305, Contraband Bayou

revisions thereof, all major and significant minor dischargers to Contraband Bayou should test effluents for chronic toxicity at least quarterly to demonstrate that unmonitored pollutants or the combination of monitored and/or unmonitored pollutants are not causing instream toxicity.

All priority organic compounds should be monitored quarterly in Contraband Bayou for one year to confirm that no priority organics exceed water quality criteria. Sampling should be conducted at four locations: one above the Lake Charles WWTPs, one at the mouth, and two equally spaced between the first two locations.

TMDLS FOR SUBSEGMENT 030301, UPPER CALCASIEU ESTUARY

Subsegment 030301 of the Calcasieu River Basin has a drainage basin of approximately 29,000 acres. The subsegment covers the portion of the Calcasieu Estuary and Ship Channel that flows from the saltwater barrier located just upstream of Lake Charles, through western Lake Charles (030302), Coon Island Loop, Clooney Island Loop, west of Lake Prien (030303), to just above Moss Lake (030304). Major tributaries feeding this basin are Bayou Verdine (030306) and Bayou D'Inde (030901) from the west, and Contraband Bayou (030305) from the east. Bayou Verdine discharges at the northern edge of Coon Island Loop. Bayou D'Inde discharges near the northern edge of Prien Lake. Contraband Bayou discharges near the port of Lake Charles between Clooney and Coon Island Loops. See Figure 5 for the location of subsegment 030301.

Below Coon Island Loop, the ship channel flows southwest, partially isolating Prien Lake (on the North East). The northern part of Prien Lake receives inflow from the ship channel, and the lake's outflow discharges back into the ship channel downstream of the mouth of Bayou D'Inde. There is also a connection between the ship channel and Prien Lake across from the mouth of Bayou D'Inde. After the confluence of the Prien Lake portion of the original river and the Calcasieu Ship Channel, the Calcasieu Estuary flows south to Moss Lake.

The Calcasieu Estuary has been substantially altered by dredging to accommodate ship traffic in the vicinity of Lake Charles. The construction of the Calcasieu Ship Channel in 1941 altered the salinity regime of the Calcasieu Estuary by removing the river's natural saltwater barrier. The change in salinity impacted marsh areas to the west of Calcasieu Lake, and water control structures were installed by the USFWS to reduce these impacts. The man-made saltwater barrier upstream of Lake Charles prevents further upstream movement of saltwater. The subsegment is tidally-influenced, with salinity stratification caused by the interaction of saltwater from the Gulf of Mexico (to the south) moving northward and fresh water moving south. Waters upstream of the saltwater barrier are fresh.

The ship channel in subsegment 030301 is approximately 17 miles long down its centerline while the river, including loops, lakes, and meanders is approximately 25 miles long. The U.S. Army Corps of Engineers maintains the ship channel at a depth of approximately 45 feet. The undredged river channel ranges from 15 to 45 feet in depth.

Subsegment 030301 incorporates the river and ship channel portions of the Superfund Upper and Lower Calcasieu River Areas of Concern (AOCs).

Designated Uses

LDEQ designates subsegment 030301 for primary contact recreation, secondary contact recreation, propagation of fish and wildlife, and agriculture (LAC:33.IX.1123.a, Table 3). The Calcasieu Estuary and Ship Channel is not a drinking water source. The estuary currently supports a recreational fishery targeted primarily on sea trout, redfish, black drum, and flounder. In addition, commercial fisheries for shrimp and crab exist in the southern portions of the estuary, primarily in the ship channel.

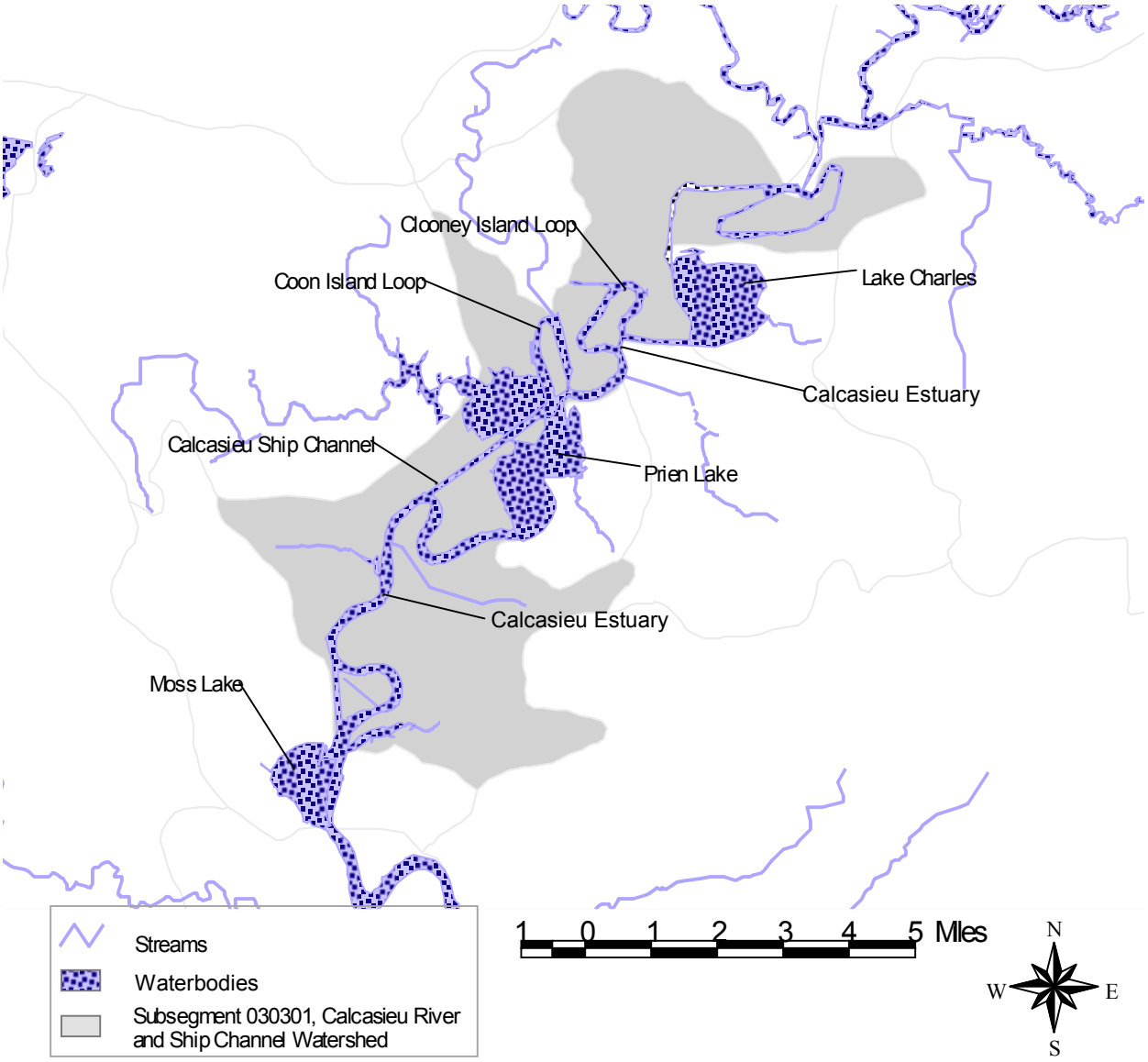

Figure 5. Location of Subsegment 030301, Calcasieu Estuary and Ship Channel

The Calcasieu Estuary also has several delineated wetlands that are considered sensitive environments.

Pollutants of Concern

EPA's 303(d) List identifies priority organics, contaminated sediments, copper, mercury, and ammonia as pollutants causing impairment of this subsegment.

Using the procedures specified in the Methodology section, eight specific pollutants of concern are identified for the Upper Calcasieu Estuary and Ship Channel (Table 20). Three are identified on EPA's 303(d) List (Table 1), and two of the three also have water concentrations that exceed Louisiana's water quality criteria. Five pollutants are selected based on exceedances of their respective ERMs in sediments.

Table 20. Pollutants of Concern for Upper Calcasieu Estuary and Ship Channel (030301)

Pollutant	Medium	Basis for Selection
Priority Organics	Water	On 303(d) List
Ammonia	Water	On 303(d) List
Copper	Water	On 303(d), water quality dissolved criterion exceedances
Mercury	Water & Sediment	On 303(d), water quality dissolved criterion exceedances, ERM Exceedances
Contaminated Sediments	Sediment	On 303(d) List
Acenaphthene	Sediment	ERM exceedances
Benzo (a) Anthracene	Sediment	ERM exceedances
Benzo (a) Pyrene	Sediment	ERM exceedances
Phenanthrene	Sediment	ERM exceedances
Pyrene	Sediment	ERM exceedances

The following sections present discussions on each of the pollutants in this table.

303(D) LIST

Priority Organics

EPA's 303(d) List identifies priority organics as a category of pollutants of concern in water in this subsegment. Only two or three samples were taken for organic compounds (depending on the pollutant), and the majority of compounds are not detected (Appendix Table B-1). Only methylene chloride and toluene are detected, both concentrations lower than applicable criteria. Five PAHs, however, exceed sediment quality guidelines, and a TMDL for these pollutants is developed under Contaminated Sediments, below. Priority organics are addressed in this document through the TMDL for PAHs, receiving water monitoring, and whole effluent testing of major and significant minor discharges.

MONITORING. Consistent with EPA Region 6's Policy for Third Round NPDES Permitting (EPA 1992a) and Post Third Round Permit Implementation Strategy (EPA 1992b) or the most recent revisions thereof, all major and significant minor dischargers to the Upper Calcasieu Estuary should test effluents for chronic toxicity at least quarterly to demonstrate that unmonitored pollutants or the combination of monitored and/or unmonitored pollutants are not causing instream toxicity.

Subsegment 030301 should be monitored for priority organic compounds quarterly for one year to confirm no priority organic pollutant exceeds water quality criteria. Five stations should be monitored: between Lake Charles and the Clooney Island Loop, between the Clooney Island and Coon Island Loops, in the Ship Channel west of Prien Lake, and just above Moss Lake.

Ammonia

Ammonia is a pollutant of concern because it is on EPA's court-ordered 303(d) List. It is assumed that ammonia was placed on the list because of ammonia toxicity, and this analysis focuses on ammonia toxicity. There are no water or sediment data for ammonia.

POINT SOURCES. Nine of the 13 facilities that are reasonably expected to discharge ammonia to the Calcasieu Estuary and Ship Channel (Appendix Table E-5) are permitted to discharge ammonia (Appendix Table E-6). Reported ammonia loads from these facilities are presented in Appendix Table E-7 and Table 21) The Sulphur WWTP is not permitted to discharge ammonia but probably does so (a discharge of about 100 pounds per day is expected based on discharge from the Lake Charles WWTP).

Table 21. Existing and Permitted Loads of Ammonia, Calcasieu Estuary and Ship Channel (Subsegment 030301)

Chemical	Mean Load (pounds/day)	Maximum Load (pounds/day)	Average Permitted Load (pounds/day)	Maximum Permitted Load (pounds/day)
WR Grace & Co	446	860	1,850	3,700
Conoco Lake Charles Refinery	45.9	35	531	1,062
Sasol North America Inc.	5.42	85	41	88
Basell USA Inc Lake Charles Plant	0.941	3.73	15	20
Lyondell Chemical World Wide Inc	228	1,650	1,417	3,325
Citgo Petroleum Corporation	254	2,250	1,699	3,701
City of Lake Charles WWTP	100		279	
Calcasieu Refining Company	0.34	2.7	4	8
City of Sulphur WWTP				
Louisiana Pigment Company L.P				
Westlake Petrochemicals Corporation				
Westlake Styrene Corporation				
Westlake Polymers Corporation				
Total	1,080	4,890	5,840	11,900

NONPOINT SOURCES. Low-flow urban nonpoint source discharges of ammonia to this subsegment are estimated to be 6.67 pounds per day (Appendix Table F-1).

ATMOSPHERIC DEPOSITION. TRIS data indicate an average daily air release of 593 pounds of ammonia in the four parishes surrounding the Calcasieu Estuary (Appendix Table F-5), but because of its volatility, the pollutant is likely widely dispersed such that only a very small amount reaches the upper Calcasieu Estuary and Ship Channel. The amount, however, cannot be quantified.

TMDL. Ammonia is a nonconservative pollutant. Ammonia is taken up by plants, is converted to other nitrogen forms such as nitrites and nitrates, and is lost to the atmosphere through diffusion across the water surface. An allowable load of ammonia thus should be based on a model that incorporates these processes. Existing sources of ammonia, however, are much less than the assimilative capacity of ammonia as a conservative pollutant (56,800 pounds per day using a

criterion based on EPA's saltwater ammonia criterion and critical low flow for the Calcasieu Estuary and Ship Channel). Even if all tributary sources are added (less than 500 pounds per day), maximum discharges would still be far below the allowable load. Therefore, no TMDL is developed for ammonia. There is no evidence that ammonia is causing impairment of this subsegment, and ammonia should be delisted for this subsegment.

MONITORING. All dischargers currently monitoring ammonia should continue monitoring as specified in current permits.

Subsegment 030301 should be monitored for ammonia monthly for at least one year, and monthly for one year at five-year intervals, to demonstrate that EPA's chronic saltwater criterion for ammonia is being met in the estuary. Monitoring should be conducted at five stations: between Lake Charles and the Clooney Island Loop, between the Clooney Island and Coon Island Loops, in the Ship Channel west of Prien Lake, and just above Moss Lake.

Copper

Copper is a pollutant of concern because it appears on EPA's court-ordered 303(d) list for this subsegment (Table 1) and because approximately two thirds of all samples exceed Louisiana's chronic water quality criterion for dissolved copper (Appendix Tables B-1 through B-4). Although a few samples of copper in sediments exceed the copper ERM, sediment contamination by copper does not appear to be widespread (Appendix Tables B-6 and B-7). See Appendix Figure C-4 for the location of all copper exceedances.

SAIC (2001) tested sediment toxicity after various treatments that removed or inactivated certain classes of pollutant compounds to determine what compounds are responsible for observed toxicity. The sample for subsegment 030301 was taken from Coon Island Loop.

The sample before treatment was only slightly toxic to test species. Toxicity was moderately removed by treating for organic compounds and slightly removed by treating for a group of metals (including copper and mercury). The sample remained slightly toxic after all treatments. These results appear consistent with the relatively low level of copper contamination in sediments.

UPSTREAM AND TRIBUTARY SOURCES. The Calcasieu River (subsegment 030201) forms the upper Calcasieu Estuary and Ship Channel at the saltwater barrier above Lake Charles. Three tributaries (described above) also drain to this subsegment. Estimated loads from these sources are presented in Table 22.

POINT SOURCES. Only 2 of the 13 dischargers that are reasonably expected to discharge copper (Appendix Table E-5) are permitted to discharge copper to the Upper Calcasieu Estuary and Ship Channel (Appendix Table E-6, Table 23). Both of these facilities have monitoring data for copper (Appendix Table E-7, Table 23)

NONPOINT SOURCES. Low-flow urban nonpoint source discharges of copper to this subsegment are estimated to be 0.285 pounds per day (Appendix Table F-1).

ATMOSPHERIC SOURCES. TRIS data indicate an average daily air release of 0.00137 pounds of copper and 1.39 pounds of copper compounds in the four parishes surrounding the Calcasieu Estuary (Appendix Table F-5). The behavior of copper in the atmosphere depends on the form in

which it was released, and this is not known. It is likely, however, that atmospheric copper would not contribute an appreciable load to the upper Calcasieu Estuary and Ship Channel.

Table 22. Estimated Upstream and Tributary Loads of Copper, Upper Calcasieu Estuary and Ship Channel (030301)

Source	Estimated Load (pounds per day)
Calcasieu River	1.43[1]
Bayou Verdine	0.00614[2]
Contraband Bayou	0.01073[3]
Bayou D'Inde	0.00237[4]
Total	1.45

1 Based on average of LDEQ data using clean techniques provided by Region 6 for subsegment 030201 and low flows for the Calcasieu River (Table 4)

2 Based on average of LDEQ Ambient Water Quality Network data for 1999, with nondetects used as 1/2 the detection limit, and low flows for Bayou Verdine (Table 4)

3 Based on EPA Superfund total copper data and LDEQ Ambient Water Quality Network data for 1999, with nondetects used as 1/2 the detection limit, and low flows for Contraband Bayou (Table 4)

4 Based on TMDL for Bayou D'Inde (Table 4)

Table 23. Existing and Permitted Loads for Copper, Upper Calcasieu Estuary and Ship Channel (030301)

Facility	Mean Load (pounds/day)	Maximum Load (pounds/day)	Average Permitted Load (pounds/day)	Maximum Permitted Load (pounds/day)
WR Grace & Co	-	-	-	-
Conoco Lake Charles Refinery	-	-	-	-
Sasol North America Inc.	-	-	-	-
Basell USA Inc Lake Charles Plant	-	-	-	-
Lyondell Chemical World Wide Inc	-	-	-	-
Citgo Petroleum Corporation	-	-	-	-
City of Lake Charles WWTP	-	-	-	-
Calcasieu Refining Company	-	-	-	-
City of Sulphur WWTP	0.785	1.08	0.73	1.73
Louisiana Pigment Company L.P	-	0.922	0.647	1.538
Westlake Petrochemicals Corporation	-	-	-	-
Westlake Styrene Corporation	-	-	-	-
Westlake Polymers Corporation	-	-	-	-
Total	0.785	2.002	1.377	3.268

TMDL. Using the procedures described in the Methodology section, the assimilative capacity load for the Upper Calcasieu Estuary (less a 20% margin of error) is 46.8 pounds per day (Table E-11). Wasteload allocations for each facility appear in Appendix Table E-14 and Table 24.

Table 24. TMDL for Copper, Upper Calcasieu Estuary and Ship Channel (030301)

Facility	Wasteload Allocation (pounds/day)	Load Allocation (pounds/day)	Margin of Safety (pounds/day)	TMDL (pounds/day)
WR Grace & Co	3.18			
Conoco Lake Charles Refinery	5.29			
Sasol North America Inc.	2.44			
Basell USA Inc Lake Charles Plant	1.3			
Lyondell Chemical World Wide Inc	4.59			
Citgo Petroleum Corporation	11.3			
City of Lake Charles WWTP	0.94			
Calcasieu Refining Company	1.56			
City of Sulphur WWTP	7.6			
Louisiana Pigment Company L.P	1.55			
Westlake Petrochemicals Corporation	1.29			
Westlake Styrene Corporation	0.227			
Westlake Polymers Corporation	0.185			
Total	41.452	5.348	11.700	58.500

Note: The wasteload allocation is a maximum daily allocation.

MONITORING. Each facility should monitor process effluents at least quarterly, using clean techniques, to demonstrate compliance with these wasteload allocations. Each facility should monitor stormwater outfalls for detectable levels of copper at least quarterly.

Copper concentrations in subsegment 030301 should be monitored using clean techniques near the mouths of tributaries at least monthly for a period of one year to determine the pattern of tributary concentrations over varying flows and assess whether tributary loads are higher than have been estimated using currently available data. Copper concentrations should also be monitored in this subsegment monthly to determine how frequently criterion exceedances occur. Monitoring should be conducted at five stations: between Lake Charles and the Clooney Island Loop, between the Clooney Island and Coon Island Loops, in the Ship Channel west of Prien Lake, and just above Moss Lake.

Mercury

Mercury is a pollutant of concern because it appears on EPA's court-ordered 303(d) list (Table 1) and water concentrations of dissolved mercury exceed Louisiana's chronic aquatic life criterion (Appendix Table A-1) more than once (Appendix Tables B-1, B-2, and B-3). Sediment concentrations exceed the mercury ERM in several samples, but less than 10% of all samples exceed the mercury ERM (Appendix Tables B-5 and B-6). See Appendix Figure C-3 for the location of all mercury exceedances.

UPSTREAM AND TRIBUTARY SOURCES. The Calcasieu River (subsegment 030201) forms the upper Calcasieu Estuary and Ship Channel at the saltwater barrier above Lake Charles. Three tributaries (described above) also drain to this subsegment. Estimated loads from these sources are presented in Table 25.

Table 25. Estimated Upstream and Tributary Loads of Mercury, Upper Calcasieu Estuary and Ship Channel (030301)

Source	Estimated Load (pounds per day)
Calcasieu River	0.000597[1]
Bayou Verdine	0.000062[2]
Contraband Bayou	0.000067[3]
Bayou D'Inde	0.000014[4]
Total	0.0007266

1 Based on average of LDEQ data using clean techniques provided by Region 6 for subsegment 030201 and low flows for the Calcasieu River (Table 4)

2 Based on chronic criterion and low flows for Bayou Verdine (Table 4)

3 Based on chronic criterion and low flows for Contraband Bayou (Table 4)

4 Based on chronic criterion and low flows for Bayou D'Inde (Table 4)

POINT SOURCES. Only 2 of the 13 facilities reasonably expected to discharge mercury to the Upper Calcasieu Estuary (Appendix Table E-5) are permitted to discharge mercury to this subsegment (Table 26, Appendix Table E-6). Given the fact that mercury is a common contaminant at low levels, it is expected that all other facilities in this subsegment also discharge mercury.

NONPOINT SOURCES. Although mercury has the potential to enter the bayou as a nonpoint source load, there are no data on urban nonpoint source loads of the pollutant or data that allow calculation of an urban nonpoint source load.

ATMOSPHERIC DEPOSITION. TRIS data indicate an average daily air release of 0.824 pounds of mercury in the four parishes surrounding the Calcasieu Estuary (Appendix Table F-5). This value, however, is the 1996 annual release from PPG Industries, averaged over 4 years. Continuing deposition from a 1996 release is extremely unlikely.

Based on atmospheric deposition monitoring data at Lake Charles and the surface area of the estuary, the daily load of mercury from the atmosphere is 0.0000877 pounds of mercury per day (Appendix Table F-4), a level insufficient to cause water quality exceedances by itself.

TMDL. Using the procedures described in the Methodology section, the assimilative capacity of for the Upper Calcasieu Estuary (less a 20% margin of error) is 0.323 pounds per day (Table E-11). Wasteload allocations for each facility appear in Appendix Table E-14 and Table 27.

Table 26. Existing and Permitted Loads of Mercury, Upper Calcasieu Estuary and Ship Channel (030301)

Chemical	Mean Load (pounds/day)	Maximum Load (pounds/day)	Average Permitted Load (pounds/day)	Maximum Permitted Load (pounds/day)
WR Grace & Co				
Conoco Lake Charles Refinery				
Sasol North America Inc.				
Basell USA Inc Lake Charles Plant				
Lyondell Chemical World Wide Inc				
Citgo Petroleum Corporation				
City of Lake Charles WWTP	0.012	0.012	0.016	0.038
Calcasieu Refining Company				
City of Sulphur WWTP				
Louisiana Pigment Company L.P		0.0161	0.0319	0.0758
Westlake Petrochemicals Corporation				
Westlake Styrene Corporation				
Westlake Polymers Corporation				
Total	0.012	0.0028	0.0479	0.1138

Table 27. TMDL for Mercury, Upper Calcasieu Estuary and Ship Channel

Facility	Wasteload Allocation (pounds/day)	Load Allocation (pounds/day)	Margin of Safety (pounds/day)	TMDL (pounds/day)
WR Grace & Co	0.0219			
Conoco Lake Charles Refinery	0.0364			
Sasol North America Inc.	0.0168			
Basell USA Inc Lake Charles Plant	0.00896			
Lyondell Chemical World Wide Inc	0.0316			
Citgo Petroleum Corporation	0.0781			
City of Lake Charles WWTP	0.00649			
Calcasieu Refining Company	0.0108			
City of Sulphur WWTP	0.0524			
Louisiana Pigment Company L.P	0.0107			
Westlake Petrochemicals Corporation	0.00891			
Westlake Styrene Corporation	0.00157			
Westlake Polymers Corporation	0.00127			
Total	0.2859	0.0371	0.0808	0.4038

Note: The wasteload allocation is a maximum daily allocation.

MONITORING. Each facility should monitor process effluents at least quarterly, using clean techniques, to demonstrate compliance with these wasteload allocations. Each facility should monitor stormwater outfalls for detectable levels of mercury, using clean techniques, at least quarterly.

Mercury concentrations should be monitored near the mouths of tributaries using clean techniques at least monthly for a period of one year to determine the pattern of tributary concentrations over varying flows and assess whether tributary loads are higher than have been estimated using currently available data. Total and dissolved mercury concentrations should be monitored in this subsegment monthly using clean techniques to determine how frequently criterion exceedances occur. Monitoring should be conducted at five stations: between Lake Charles and the Clooney Island Loop, between the Clooney Island and Coon Island Loops, in the Ship Channel west of Prien Lake, and just above Moss Lake. Sediment concentrations of mercury should be measured once every five years at the same locations to ensure subsegment sediments are declining as a result of this TMDL.

Contaminated Sediments

Concentrations of mercury and several PAHs exceed sediment quality guidelines in the Upper Calcasieu Estuary and Ship Channel and are likely the source of sediment toxicity. Mercury is discussed above under 303(d) List; PAHs are discussed below under sediment quality guidelines.

MONITORING AND FOLLOW UP. The contaminated sediment TMDLs calculated for the Upper Calcasieu Estuary and Ship Channel assume that pollutants identified as pollutants of concern are responsible for observed sediment toxicity. The identified pollutants, however, may not be the only sources of sediment toxicity. To ensure that the TMDLs for this subsegment protect sediments, Louisiana should monitor sediment toxicity (using methodologies specified in EPA/600/E-94/025) at least once every five years at five stations: between Lake Charles and the Clooney Island Loop, between the Clooney Island and Coon Island Loops, in the Ship Channel west of Prien Lake, and just above Moss Lake.

Should sediment toxicity remain after the TMDLs have been implemented, Louisiana should undertake a toxicity identification evaluation (TIE) to determine the pollutant or pollutants responsible for sediment toxicity. Once pollutants have been identified, appropriate point source or nonpoint source controls should be implemented to reduce sediment toxicity.

SEDIMENT QUALITY

PAHs

Using the procedures specified in the Methodology section, PAHs are pollutants of concern because sediment concentrations of five PAHs exceed their respective ERMs in more than 10% of samples (Appendix Table B-6). Data on water concentrations of PAHs indicate infrequent detects, all below EPA's recommended water quality criteria (Appendix Table B-1). The PAHs exceeding ERMs are presented in Table 28. Concentrations of other PAHs also exceed ERMs, but concentrations are greater than ERMs in less than 10% of samples (Appendix Table B-6). See Appendix Figure C-5 for the location of all PAH exceedances.

Table 28. PAHs of Concern, Upper Calcasieu Estuary and Ship Channel

Chemical	Number of Samples	Number of Detects	Minimum Detection Level (µg/kg)	Maximum Detected Value (µg/kg)	Mean of Detected Values (µg/kg)	Number > ERM	Percent > ERM
Acenaphthene	89	15	52	12,000	2,581	9	10.1
Benzo (a) Anthracene	109	44	33	12,000	1,655	12	11.0
Benzo (a) Pyrene	107	42	33	12,000	1,652	11	10.3
Phenanthrene	107	41	40	18,000	2,882	15	14.0
Pyrene	124	67	33	24,000	2,807	22	17.7

POINT SOURCES. Four of the ten facilities in the Upper Calcasieu Estuary and Ship Channel are permitted to discharge a variety of PAHs (Table 29, Appendix Table E-6).

Table 29. Existing and Permitted Loads of Benzo (a) Pyrene, Upper Calcasieu Estuary and Ship Channel (030301)

Facility	Mean Load (pounds/day)	Maximum Load (pounds/day)	Average Permitted Load (pounds/day)	Maximum Permitted Load (pounds/day)
Conoco Lake Charles Refinery				
Sasol North America			0.2	0.53
Basell USA Inc	ND		0.22	.0.58
Lyondell Chemical World Wide	ND		0.14	0.38
Citgo Petroleum				
Calcasieu Refining Company				
Westlake Petrochemicals	ND		0.11	0.29
Westlake Styrene Corporation	ND			
Westlake Polymers Corporation	ND			
Total	ND		0.67	1.78

NONPOINT SOURCES. While PAHs can occur as nonpoint source loads, PAHs typically are strongly bound to sediments and would be discharged only during very high runoff events. There are no data on urban nonpoint source loads of PAHs and no data that allow the estimation of possible urban nonpoint source loads.

ATMOSPHERIC DEPOSITION. The TRIS database indicates that, on average, about 20 pounds of PAHs are released to air daily in the four-parish area surrounding the Calcasieu Estuary (Appendix Table F-5). PAHs are typically released as fine particles which have very slow settling rates in the atmosphere. Thus, they are widely dispersed from sources, and are unlikely to be deposited into subsegment 030301 in discernable quantities.

TMDL. Point source controls for all PAHs are similar, and if one target compound is removed, other PAHs will also be removed. Two of the nine PAHs causing sediment impairment (benzo (a) anthracene and benzo (a) pyrene) have the same EPA-recommended water quality human health criterion of 0.049 µg/L (Appendix Table A-1). This criterion is used in calculating the TMDL for the Upper Calcasieu Estuary and Ship Channel.

Using the procedures described in the Methodology section, the assimilative capacity of for the Upper Calcasieu Estuary (less a 20% margin of error) is 1.9 pounds per day (Table E-11). Wasteload allocations for each facility appear in Appendix Table E-14 and Table 30.

Table 30. TMDL for Benzo (a) Anthracene and Benzo (a) Pyrene, Upper Calcasieu Estuary and Ship Channel

Facility	Wasteload Allocation (pounds/day)	Load Allocation (pounds/day)	Margin of Safety (pounds/day)	TMDL (pounds/day)
Conoco Lake Charles Refinery	0.314			
Sasol North America	0.164			
Basell USA Inc	0.0875			
Lyondell Chemical World Wide	0.309			
Citgo Petroleum	0.762			
Calcasieu Refining Company	0.0908			
Westlake Petrochemicals	0.087			
Westlake Styrene Corporation	0.0153			
Westlake Polymers Corporation	0.0124			
Total	1.842	0.058	0.475	2.375

Note: The wasteload allocation is an average monthly allocation.

MONITORING. All facilities with wasteload allocations should monitor their effluents for PAHs using the most sensitive approved analytical methods at least quarterly to demonstrate compliance with these wasteload allocations.

All PAH pollutants of concern in the sediments should be monitored in and around Indian Marais and in Coon Island Loop at five-year intervals to ensure this TMDL is causing sediment concentrations of PAHs to decline. At least four stations should be monitored during each monitoring period: one station near Indian Marais, one station one mile north of Indian Marais, one station at the confluence of Bayou Verdine and Coon Island Loop, and one half way between the confluence of Bayou Verdine and Coon Island Loop and the northern confluence of Coon Island Loop with the Ship Channel. All stations should be shoreline stations.

TMDLS FOR SUBSEGMENT 030302, LAKE CHARLES

Subsegment 030302 of the Calcasieu River Basin, located in Calcasieu Parish, includes Lake Charles and Python Bayou. Lake Charles receives water from the Upper Calcasieu River subsegment 030301, which begins at the saltwater barrier just upstream of the lake. In addition to the Calcasieu River, whose channel passes through approximately 1.5 miles of the western perimeter, Lake Charles receives water from Python Bayou, a one-mile long tributary flowing from the east. See Figure 6 for the location of subsegment 030302.

The 2,900-acre drainage basin is approximately 2 miles long and 2.3 miles wide, extending from the ship channel on either side of the lake to approximately 2 miles east of the lake. It includes much of the area of the city of Lake Charles. The lake covers approximately 1,016 acres. The surface elevation in the area around the reaches of Upper Calcasieu River averages about 10 feet above mean sea level (msl). The area in the immediate vicinity of the lake lies within the 100-year flood plain of the Calcasieu River Basin (PRC 1994).

The Upper Calcasieu river channel is approximately 6,000 feet wide in the Lake Charles subsegment. Lake Charles is tidally-influenced, with salinity stratification promoted by the interaction of salt water from the Gulf of Mexico (to the south) moving northward and fresh water moving south.

The Upper Calcasieu River Area of Concern (AOC) includes Lake Charles as described by the ongoing Remedial Investigation/Feasibility Study (RI/FS) effort of the Calcasieu Estuary Cooperative Sites. Subsegment 030302 incorporates the Lake Charles portion of the Upper Calcasieu River AOC.

Designated Uses

LDEQ designates Lake Charles for primary contact recreation, secondary contact recreation, and propagation of fish and wildlife (LAC 33:IX,1123.A, Table 3). The subsegment is not a drinking water source. Lake Charles also supports recreational and commercial fishing and has several delineated wetlands that are considered sensitive environments.

Pollutants of Concern

EPA's court-ordered 303(d) List identifies two categories of pollutants for Lake Charles: priority organics and nonpriority organics (Table 1). As explained in the Methodology section, data are used, when available, to identify specific priority organic pollutants of concern. There are no data for Lake Charles, so no priority organic or nonpriority organics pollutants of concern are identified. Actions required for priority organics and nonpriority organics are discussed below.

Available water and sediment data were evaluated for criterion exceedances (Appendix Tables B-8, B-9, and B-10). There are no exceedances of Louisiana's water quality criteria and no exceedances of sediment ESGs or ERMs.

No specific pollutants of concern are identified for Lake Charles.

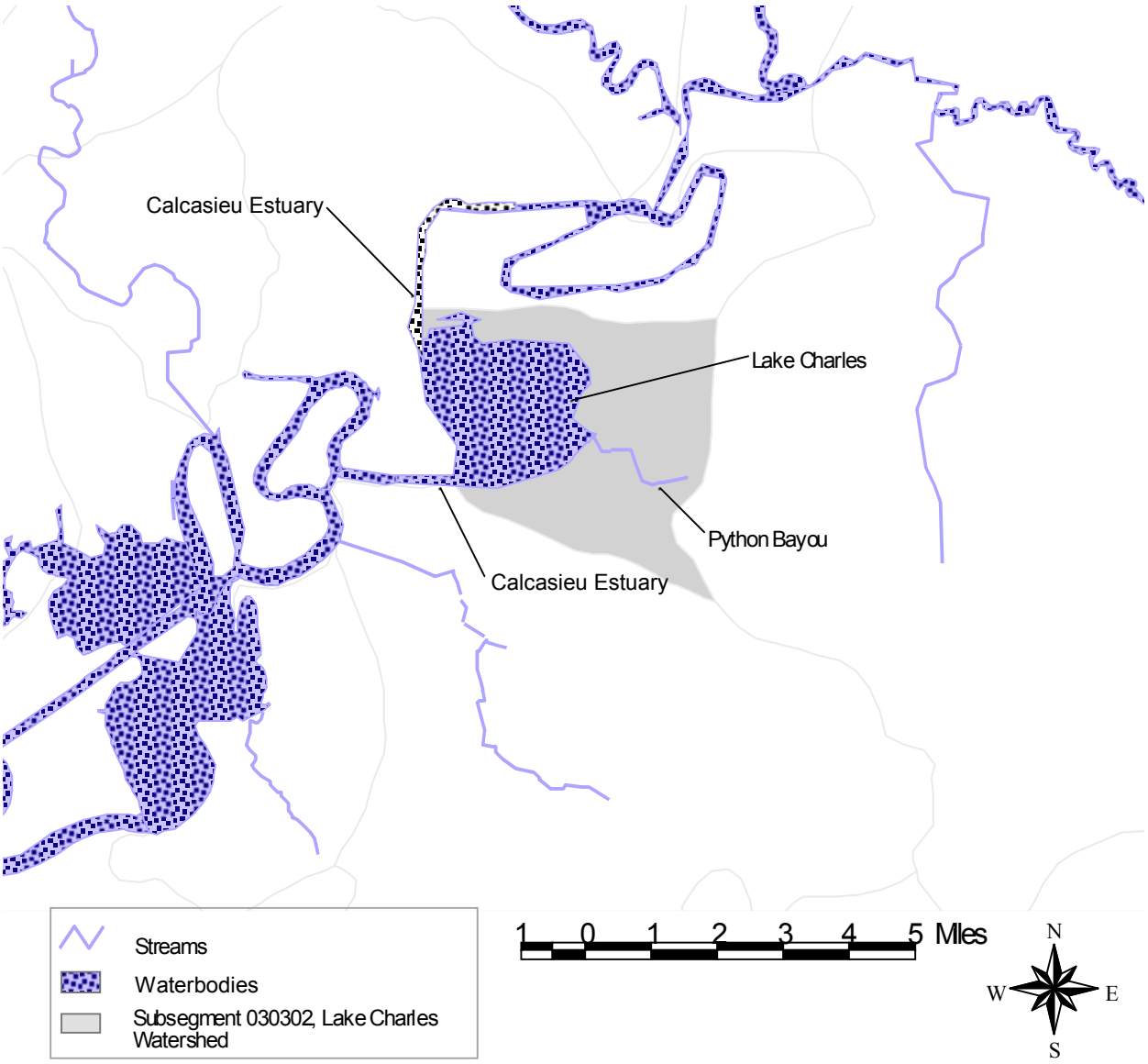

Figure 6. Location of Subsegment 030302, Lake Charles

Priority Organics

There are no known or suspected discharges of priority organics to Lake Charles. Sediment data indicate no ESG or ERM exceedances for priority organics (Appendix Tables B-9 and B-10). There is no evidence that priority organics are causing impairment of this subsegment. Therefore, this subsegment should be delisted for priority organics. Any possible future impairment of this subsegment by priority organics would be prevented by controlling the effluent toxicity of nearby major and significant minor dischargers that do not discharge directly to Lake Charles.

MONITORING. Lake Charles should be monitored for priority organics quarterly for one year at two stations: one in the center of the lake and one half way between the lake center and the eastern shoreline to confirm the absence of water quality exceedances for priority organics.

Nonpriority Organics

There are no known or suspected discharges of nonpriority organics to Lake Charles. Sediment data indicate no ESG or ERM exceedances for nonpriority organics (Appendix Tables B-9 and B-10). There is no evidence that nonpriority organics are causing impairment of this subsegment. Therefore, this subsegment should be delisted for nonpriority organics. Any possible future impairment of this subsegment by nonpriority organics would be prevented by controlling the effluent toxicity of nearby major and significant minor dischargers that do not discharge directly to Lake Charles.

TMDLS FOR SUBSEGMENT 030303, PRIEN LAKE

Prien Lake, subsegment 030303, lies on the southwestern edge of Lake Charles, adjacent to part of the Lower Calcasieu River. The northern part of Prien Lake receives inflow from the Ship Channel at Coon Island Loop, opposite Bayou D'Inde. The lake's outflow discharges on the south side through a 3-mile long meander that leads back into the Ship Channel downstream of the mouth of Bayou D'Inde. See Figure 7 for the location of subsegment 030303.

Prien Lake is approximately 2 miles long and one mile wide and covers 997 acres. The drainage basin is approximately 3 miles long and 2 miles wide, extending approximately 2 miles north and 2 miles west of the town of Prien. The drainage basin covers approximately 2,900 acres. The area surrounding Prien Lake lies within the 100-year flood plain of the Calcasieu River Basin (PRC 1994).

The Lower Calcasieu River Area of Concern (AOC) includes Prien Lake as described by the ongoing Remedial Investigation/Feasibility Study (RI/FS) effort of the Calcasieu Estuary Cooperative Sites.

Designated Uses

LDEQ designates Prien Lake for primary contact recreation, secondary contact recreation, and propagation of fish and wildlife (LAC 33:IX.1123, Table 3). The subsegment is not a source of drinking water. Prien Lake also supports recreational and commercial fishing and has several delineated wetlands that are considered sensitive environments.

Pollutants of Concern

Prien Lake is listed on EPA's court-ordered 303(d) List for priority organics in water (Table 1). As explained in the Methodology section, data are used, when available, to identify specific priority organic pollutants of concern. Based on eight or nine samples taken in Prien Lake, no organic pollutants have concentrations exceeding water quality criteria (Appendix Table B-11). Therefore, no organic pollutants are pollutants of concern. No sediment concentrations exceed appropriate ESGs or ERMs (Appendix Tables B-14 and B-15).

Priority Organics

No priority organic pollutants exceed water quality criteria in Prien Lake (Appendix Table B-11), and there are no known or suspected discharges to the lake (Appendix Table E-5). In addition, upstream (Bayou Verdine, Bayou D'Inde) controls for priority organic compounds reduce the possibility of priority organics causing impairment. This subsegment should thus be delisted for priority organics.

MONITORING. Prien Lake should be monitored for priority organic compounds quarterly for one year to confirm that no priority organic pollutants exceed applicable criteria. A series of stations (at least five) along the lake centerline should be monitored.

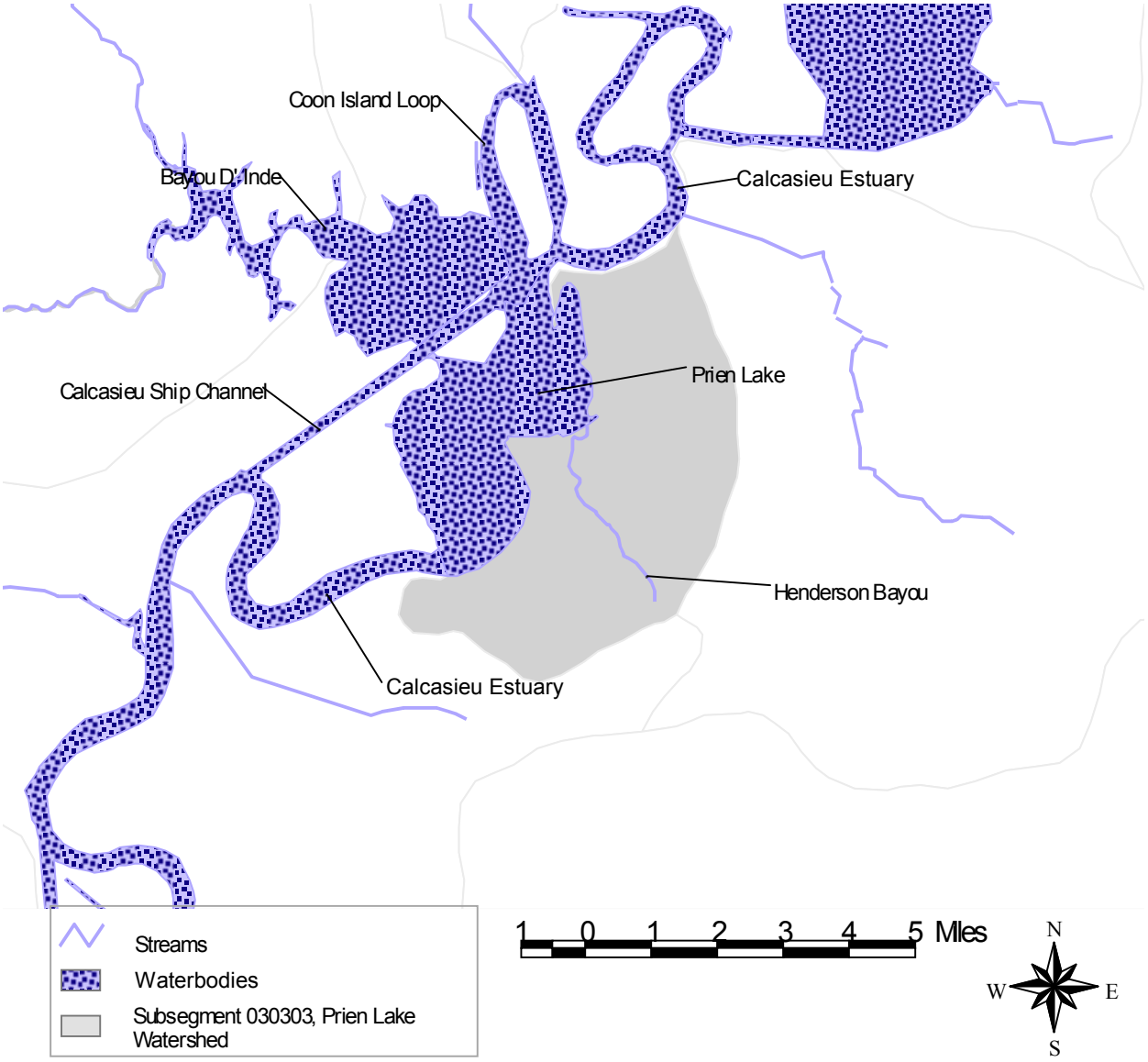

Figure 7. Location of Subsegment 030303, Prien Lake

TMDLS FOR SUBSEGMENT 030304, MOSS LAKE

Calcasieu River Basin Subsegment 030304 includes Moss Lake and Olsen Bayou. Olsen Bayou feeds into Moss Lake from the northwest portion of the drainage area. Moss Lake also receives waters from the Calcasieu River and Ship Channel, which passes through the lake from the northeast to the southeast on its way to Lake Calcasieu and then the Gulf of Mexico. See Figure 8 for the location of subsegment 030304.

The drainage basin associated with subsegment 030304 is approximately 9,000 acres; the area of Moss Lake is approximately 521 acres. The drainage basin is approximately 7 miles in length, starting 2 miles north of the town of Carlyss, extending southeast to Moss Lake, and then 2 miles southeast of the lake.

Moss Lake is the downstream extremity of the Lower Calcasieu River Area of Concern (AOC) as described by the ongoing Remedial Investigation/Feasibility Study (RI/FS) effort of the Calcasieu Estuary Cooperative Sites.

Designated Uses

LDEQ designates Moss Lake for primary contact recreation, secondary contact recreation, and propagation of fish and wildlife (LAC 33:IX.1123.A, Table 3). The subsegment is not a source of drinking water. The Calcasieu Estuary currently supports a recreational fishery primarily targeted on sea trout, redfish, black drum, and flounder. In addition, commercial fisheries for shrimp and crab exist in the southern portions of the estuary, primarily in the Ship Channel.

Pollutants of Concern

Moss Lake is listed on EPA's court-ordered 303(d) List for copper and priority organics in water (Table 1). As explained in the Methodology section, data are used, when available, to identify specific priority organic pollutants of concern. Based on limited samples taken in Moss Lake, no organic pollutants exceed water quality criteria (Appendix Table B-16). No organic pollutants are pollutants of concern. No sediment concentrations exceed appropriate ESGs or ERMs (Appendix Tables B-19 and B-20).

Copper exceeds Louisiana's chronic aquatic life criteria more than once and is a pollutant of concern (Appendix Tables B-16 through B-18). These pollutants are discussed below.

Priority Organics

There are no known or suspected discharges of priority organics to Moss Lake. Sediment data indicate no ESG or ERM exceedances for priority organics (Appendix Tables B-19 and B-20). There is no evidence that priority organics are causing impairment of this subsegment. Therefore, this subsegment should be delisted for priority organics. Any possible future impairment of this subsegment by priority organics will be prevented by controlling priority

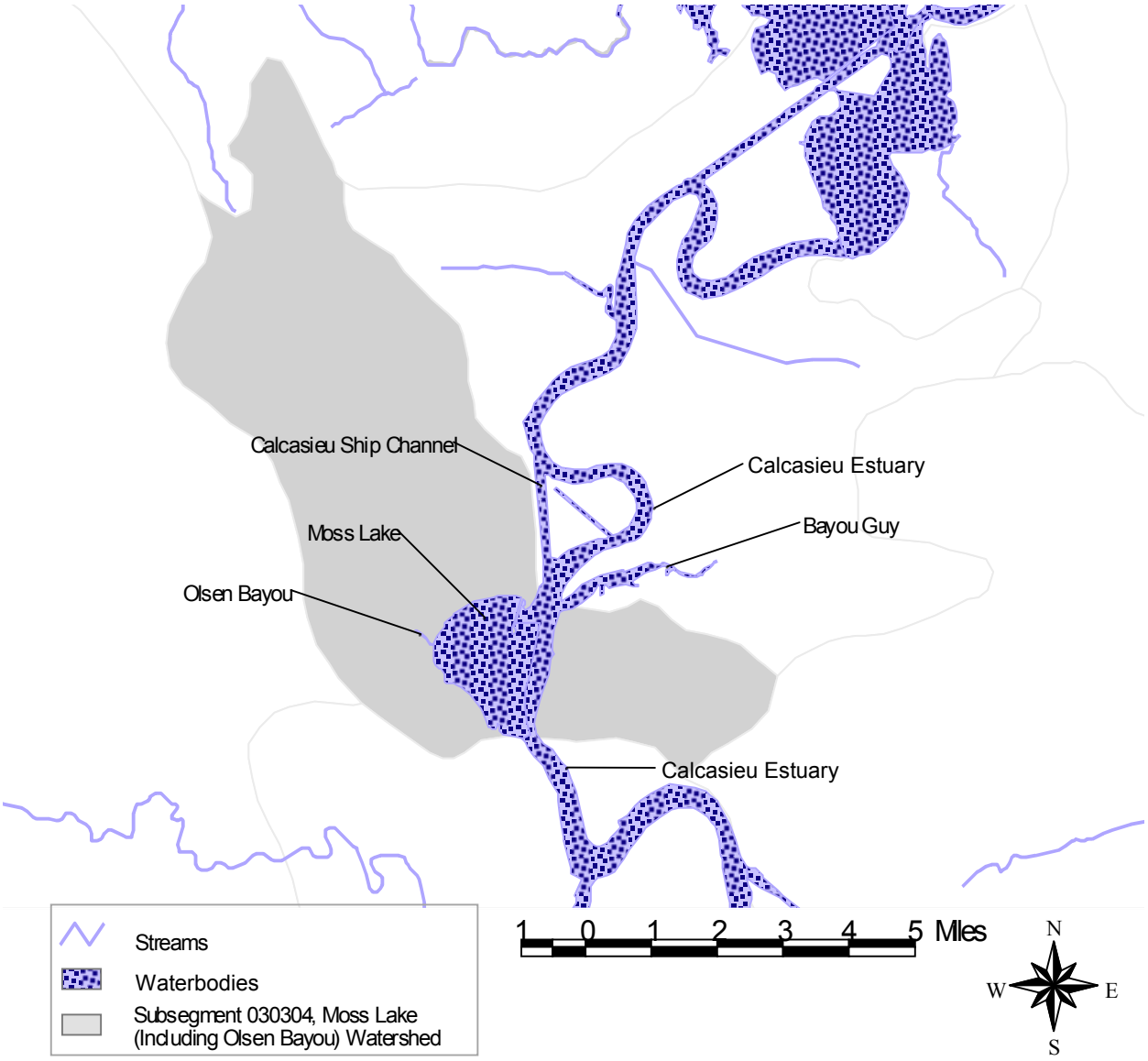

Figure 8: Location of Subsegment 030304, Moss Lake

organics upstream (Bayou Verdine, Bayou D'Inde, Upper Calcasieu Estuary and Ship Channel) and toxicity testing of major and significant minor discharges to Bayou Verdine, Bayou D'Inde and the Upper Calcasieu Estuary and Ship Channel.

MONITORING. Moss Lake should be monitored for priority organics quarterly for one year at two stations: one in the center of the lake and one half way between the lake center and the confluence of Olsen Bayou and the lake to confirm the absence of water quality exceedances for priority organics.

Copper

Copper is a pollutant of concern because it is identified on EPA's 303(d) List and measured concentrations exceed water quality criteria. Copper concentrations exceed Louisiana's dissolved chronic aquatic life criterion in 1 of 6 EPA Superfund samples (Appendix Table B-16) and the dissolved criterion in 2 of 29 LDEQ samples (Appendix Table B-18). See Appendix Figure C-4 for the location of copper exceedances based on EPA Superfund data.

UPSTREAM AND TRIBUTARY SOURCES. The Upper Calcasieu Estuary and Ship Channel flow directly into Moss Lake. The major source of copper to Moss Lake is thus the Ship Channel. Olsen Bayou flows into Moss Lake, and Bayou Guy enters the Ship Channel just above Moss Lake. There is no information on flows or concentrations of copper in either of these tributaries, so no loads can be estimated.

POINT SOURCES. No point sources with discharge data in PCS that discharge to Olsen Bayou have been identified (Appendix Table E-5). There are four small facility discharges to Moss Gully or Moss Lake (Appendix Table E-15).

NONPOINT SOURCES. The estimated low-flow urban nonpoint source load to the lake is 0.0321 pounds of copper per day (Appendix Table F-1).

ATMOSPHERIC SOURCES. TRIS data indicate an average daily air release of 0.00137 pounds of copper and 1.39 pounds of copper compounds in the four parishes surrounding the Calcasieu Estuary. The behavior of copper in the atmosphere depends on the form in which it was released, and this is not known. Given the small releases, it is unlikely that the atmosphere provides a significant load to Moss Lake.

TMDL. The TMDL for Moss Lake is established through controls in the form wasteload allocations to facilities that discharge copper to upstream subsegments. Both point source and nonpoint source discharges would be very small compared to loads coming from upstream, and their impact on water quality criterion exceedances would not be discernible. Improvement in the quality of Moss Lake will be obtained through control of upstream (Bayou Verdine, Bayou D'Inde, and Upper Calcasieu Estuary and Ship Channel) copper sources and toxicity testing for all upstream major and significant minor discharges.

MONITORING. Moss Lake should be monitored for total and dissolved copper using clean techniques at monthly intervals at two stations for one year to determine the pattern of water quality criterion exceedances for copper. One station should be located near the mouth of Olsen Bayou and the other in the center of the Ship Channel. Monthly monitoring for one year should be repeated at five-year intervals to confirm that the effects of upstream TMDLs are reducing the number of copper exceedances in Moss Lake.

TMDLS FOR SUBSEGMENT 030401, LOWER CALCASIEU ESTUARY AND SHIP CHANNEL

Subsegment 030401 encompasses the 26 mile-long portion of the Calcasieu River and Ship Channel in Cameron Parish that flows from Moss Lake to the Gulf of Mexico, excluding Calcasieu Lake (See Figure 9). The 72,000-acre drainage area incorporates the West Cove, southwest of Calcasieu Lake, and Mud Lake in addition to the Ship Channel. The entire area lies within the coastal zone of Cameron Parish, including the eastern edge of the Sabine Natural Preserve Wild Life Refuge and a sea bird colony west of West Cove.

Designated Uses

The surface waters of this subsegment have been designated by LDEQ for primary contact recreation, secondary contact recreation, propagation of fish and wildlife, and oyster propagation (LAC 33:IX.1123.A, Table 3). The subsegment is not a source of drinking water. The Calcasieu Estuary also supports recreational and commercial fishing and has several delineated wetlands that are considered sensitive environments.

Pollutants of Concern

Subsegment 030401 is listed on EPA's court-ordered 303(d) List for priority organics in water. As explained in the Methodology section, data are used, when available, to identify specific priority organic pollutants of concern. No recent data are available for organic pollutants in this subsegment. No specific organic pollutants are pollutants of concern.

Available water data were evaluated for criterion exceedances (Appendix Table B-33). No criterion exceedances were found. There are no recent sediment data for the Lower Calcasieu Estuary and Ship Channel.

No pollutants of concern are identified for subsegment 030401 and no TMDL is developed for the subsegment.

Priority Organics

There are no permitted discharges of priority organics to the Lower Calcasieu Estuary and Ship Channel, and the two facilities that might discharge priority organics are located well away from the main channel. There is no evidence that priority organics are causing impairment upstream of this subsegment (Moss Lake, Prien Lake), and there is no evidence that priority organics are causing impairment of this subsegment. Therefore, this subsegment should be delisted for priority organics. Any possible future impairment of this subsegment by priority organics would be prevented by controlling priority organics upstream (Bayou Verdine, Bayou D'Inde, Upper Calcasieu Estuary and Ship Channel) and toxicity testing of major and significant minor discharges to Bayou Verdine, Bayou D'Inde, and the Upper Calcasieu Estuary and Ship Channel.

MONITORING. The Lower Calcasieu Estuary and Ship Channel should be monitored for priority organics quarterly for one year to confirm the absence of criterion exceedances for priority organics. Monitoring should occur at one station just below East Pass.

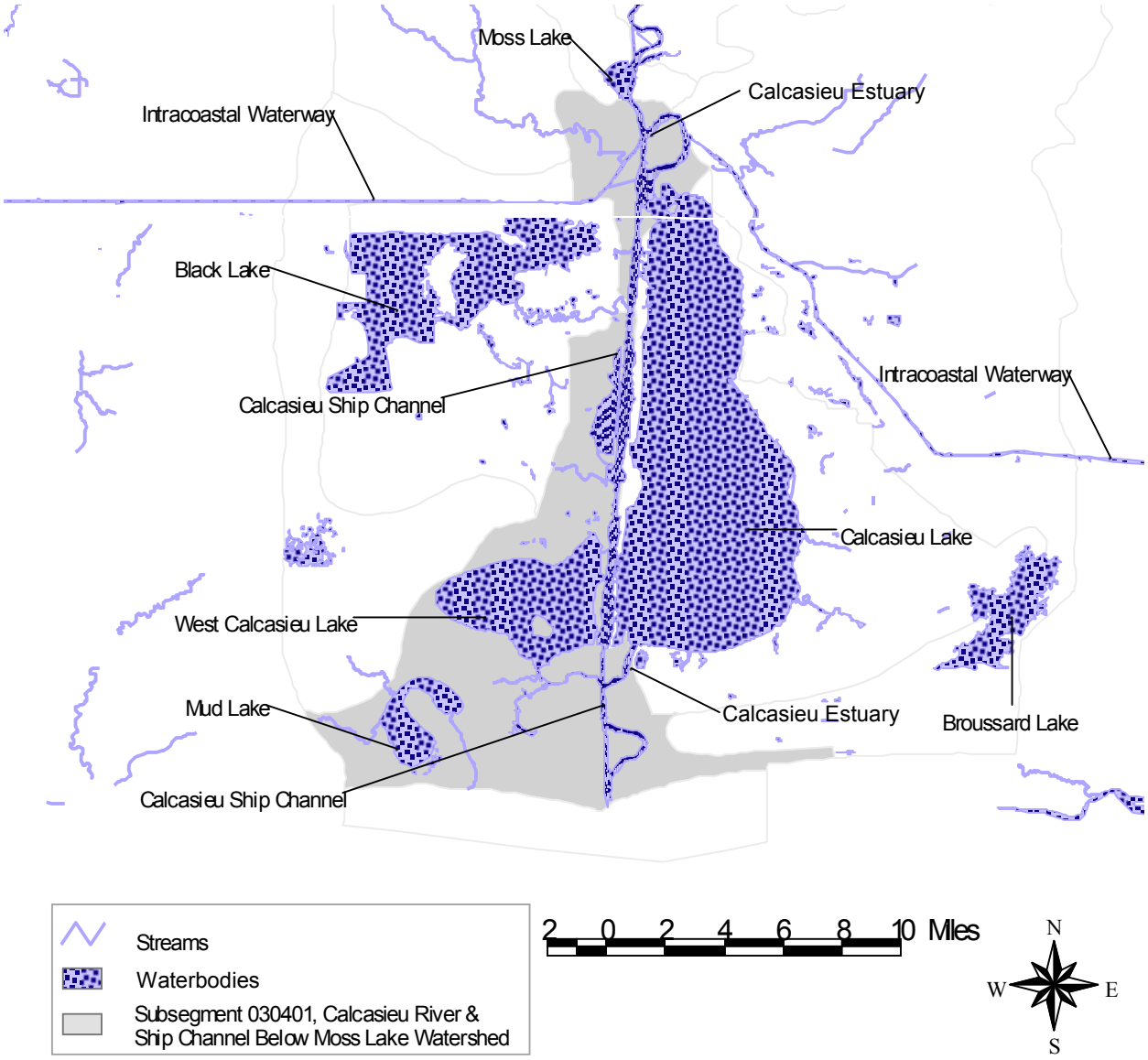

Figure 9. Location of Subsegment 030401, Lower Calcasieu Estuary and Ship Channel

TMDLS FOR SUBSEGMENT 030402, CALCASIEU LAKE

Calcasieu Lake, subsegment 030402, lies adjacent to the 26-mile-long portion of the Calcasieu River and Ship Channel in Cameron Parish Louisiana that flows from Moss Lake to the Gulf of Mexico (See Figure 10). The 88,000-acre drainage area incorporates the western edge of Broussard Lake, which is over 6 miles east of Calcasieu Lake. The entire area lies within the coastal zone of Cameron Parish and includes the Cameron Prairie Wild Life Refuge.

Calcasieu Lake, approximately 16 miles long and over 5 miles wide in some areas, covers 42,000 acres.

Designated Uses

Although the Calcasieu Lake is not used as a drinking water source, the estuary surface waters have been designated by LDEQ for primary contact recreation, secondary contact recreation, propagation of fish and wildlife, and oyster propagation (LAC 33:IX.1123.A, Table 3). The Calcasieu River also supports recreational and commercial fishing and has several delineated wetlands that are considered sensitive environments.

Calcasieu Lake is listed on EPA's court-ordered 303(d) List for priority organics in water. As explained in the Methodology section, data are used, when available, to identify specific priority organic pollutants of concern. No recent data is available for organic pollutants in this subsegment. No organic pollutants are pollutants of concern.

Available water data were evaluated for criterion exceedances (Appendix Table B-34). No criterion exceedances were found. There are no recent sediment data for the Lower Calcasieu Estuary and Ship Channel.

No specific pollutants of concern are identified for this subsegment and no TMDL is developed.

Priority Organics

There are no permitted discharges of priority organics to Calcasieu Lake. There is no evidence that priority organics are causing impairment upstream of this subsegment (Moss Lake, Prien Lake), and there is no evidence that priority organics are causing impairment of this subsegment. Therefore, this subsegment should be delisted for priority organics. Any possible future impairment of this subsegment by priority organics would be prevented by controlling priority organics upstream (Bayou Verdine, Bayou D'Inde, Upper Calcasieu Estuary and Ship Channel) and toxicity testing of major and significant minor discharges to Bayou Verdine, Bayou D'Inde, and the Upper Calcasieu Estuary and Ship Channel.

MONITORING. Calcasieu Lake should be monitored for priority organics quarterly for one year to confirm the absence of criterion exceedances for priority organics. Monitoring should occur at one station 1/2-mile inside East Pass.

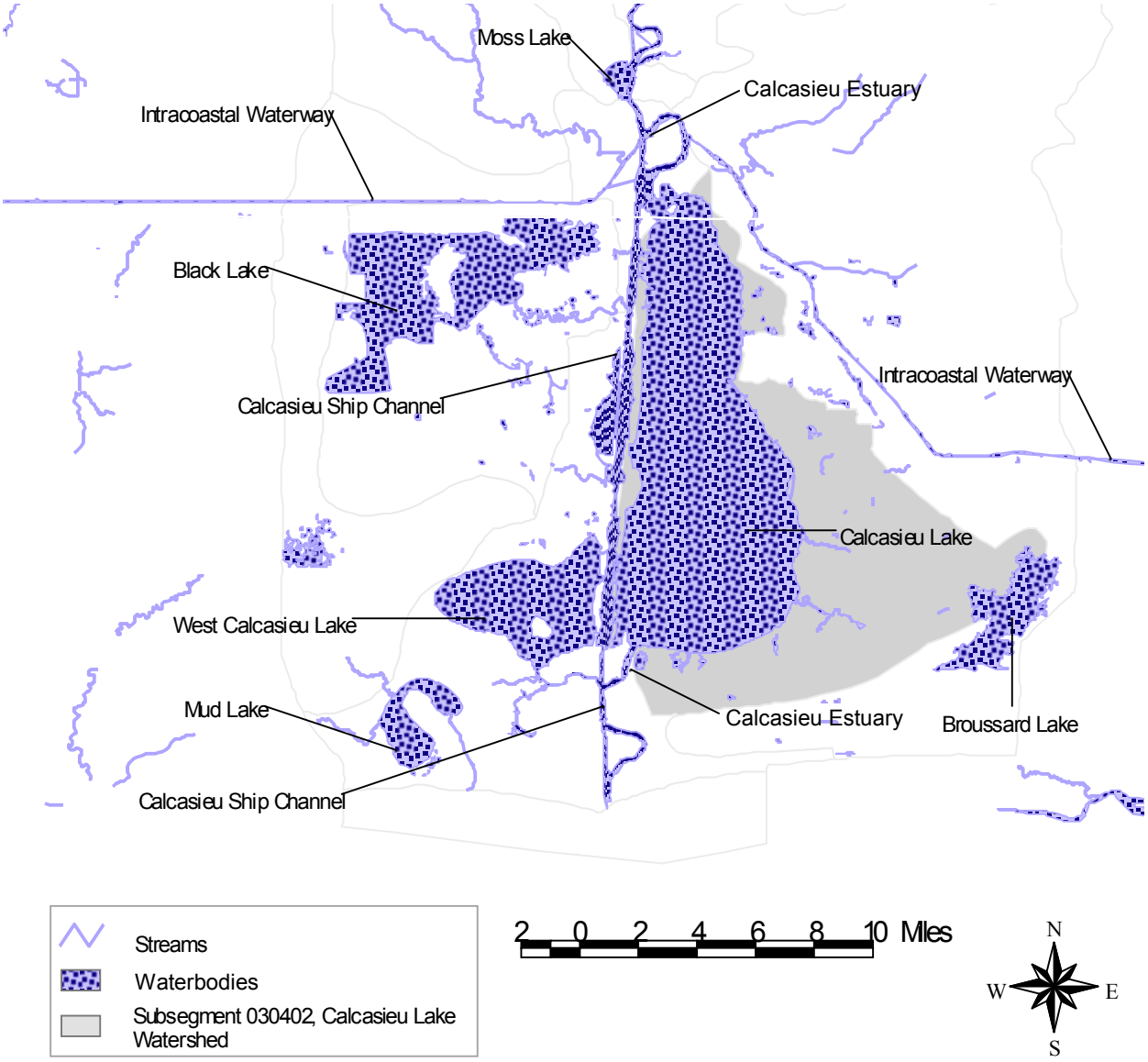

Figure 10. Location of Subsegment 030402, Calcasieu Lake

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